BOTANICAL GAZETTE

APRIL, 1896.

Notes on the North American species of Plagiochila.

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WITH PLATES XV AND XVI.

Only two species of Plagiochila are attributed to our limits in the first part of the Synopsis Hepaticarum, published in 1844, and the first of these two, *P. porelloides*, must be considered a form of the second, *P. asplenioides*. Three years afterwards, in the supplement to the same work, five additional species are given: one of these, *P. interrupta*, is here reported from Greenland alone; three of the others are species which Sullivant had described the year before and one of these, *P. macrostoma*, must be regarded as a synonym of *P. interrupta;* while the fifth species, *P. nodosa* Tayl., likewise published in 1846, is one of the many forms of *P. asplenioides*. Only four valid species, therefore, are left to our credit:—*P. asplenioides*, *P. interrupta*, and Sullivant's two species, *P. undata* and *P. Ludoviciana*.

A fifth species, *P. spinulosa*, is described in Sullivant's "Musci and Hepaticæ of the United States," published in 1856, but the specimens from which the description is drawn are very different from the true *P. spinulosa* (Dicks.) Dum. and form the type of a new species. In Dr. Millspaugh's recent "Flora of West Virginia," a sixth species is added, and this, together with the two described in the present paper, increases the total number of our species to eight. It is probable that others remain undetected, particularly in our southern and western states.

The Plagiochilæ so rarely produce organs of fructification that it is usually necessary to depend upon purely vegetative characters in distinguishing the species. The method of branching, the shape and arrangement of the leaves, the peculiarities of their margins and of their cells are all of

extreme importance in this respect. The underleaves, on the contrary, are of less value than in most hepatic genera. They are present, occasionally at least, in all our species, but they are, in most cases, minute structures deeply split into slender hair-like divisions and at first sight bear much resemblance to clusters of rhizoids. A closer inspection, however, will show that their laciniæ are multicellular and that they proceed from a basilar membrane one or more cells in height. The cells of which these underleaves are composed are not like ordinary leaf-cells; they are smaller and have much more delicate walls; but, in two of our species, peculiar, more distinctive underleaves with leaf-like texture are sometimes produced, and these will be especially noted. In the following key, none except vegetative characters are considered.

Key to the species.

Stems creeping and radiculose; leaves not decurrent. 1. *P. interrupta.*

Stems ascending from a rooting caudex, normally non-radiculose; leaves more or less decurrent.

Leaves rarely reflexed at the postical base, not forming crest-like lines parallel to the stem.

Margins of leaves either entire or denticulate, the teeth exceeding ten in number. . . . . 2. *P. asplenioides.*

Margins of leaves dentate, the teeth not exceeding ten in number.

Length of leaves averaging less than twice their width.

Teeth arising from a broad base; leaf-cells large. . . . 3. *P. Columbiana.*

Teeth arising from a narrow base; leaf-cells small. . . . 4. *P. Virginica.*

Length of leaves averaging more than twice their width.

Leaves obliquely spreading, forming an angle of 40°–45° with the stem, scarcely narrowed at the base. 5. *P. Floridana.*

Leaves widely spreading, forming an angle of 55°–70° with the stem, distinctly narrowed at the base. 6. *P. Sullivantii.*

Leaves reflexed at the postical base, forming two crest-like lines parallel to the stem.

Postical margin of leaves plane and dentate beyond the reflexed base. . . . . 7. *P. Ludoviciana.*

Postical margin of leaves repand-undulate beyond the reflexed base. . . . . 8. *P. undata.*

1. PLAGIOCHILA INTERRUPTA (Nees) Dum. Rev. Jung. 15. 1835.

P. macrostoma Sull. Musci Alleg. *n. 221.*

P. interrupta differs from all our other species in several important respects. As a result of its prostrate habit, its leaves spread horizontally and are almost flat, so that the plant has much the appearance of a Chiloscyphus, while in its inflorescence it is autoicous and not dioicous as in typical Plagiochilæ. Lindberg considered these differences sufficient to separate it from the rest of the genus, at first as a subgenus,[1] but afterwards as a distinct genus to which he gave the name of Pedinophyllum.[2] This genus is maintained by Schiffner,[3] but, as Spruce[4] points out, the characters assigned to it are scarcely of generic value, though it might be well to consider them of subgeneric. Lindberg himself had little faith in its validity; four years after its publication, he placed *P. interrupta* in Mitten's genus Leptoscyphus.[5]

Plagiochila macrostoma was first definitely referred to *P. interrupta* by Austin,[6] though even Sullivant had doubted the permanence of his species. His specimens were found on old logs and on shaded banks instead of on calcareous rocks where *P. interrupta* usually grows in Europe, but they agree pretty closely with European specimens. The principal difference which he gives, the presence of underleaves, does not hold, as these bodies may also be found on European plants. The species has not been collected recently in the United States.

2. PLAGIOCHILA ASPLENIOIDES (L.) Dum. Rev. Jung. 14. 1835.

P. porelloides (Torr.) Lindenb. Spec. Hepat. 61. *pl. 12.*

P. nodosa Tayl. Lond. Journ. Bot. **5**: 268. 1846.

P. asplenioides is very widely distributed in northern latitudes, being found in Europe, Asia and America; it grows on stones in brooks, on rocks dampened by the spray of waterfalls, on the ground in woods, on shaded rocks and banks, and at the base of trees; and its stems are either loosely massed together or scattered among other bryophytes. Specimens vary greatly in size, in the position of their leaves, and

[1] Not. Soc. pro F. et Fl. Fenn. **13**: 366. 1874.
[2] Cf. Acta Soc. Sci. Fenn. **10**: 504. 1875.
[3] Engler-Prantl, Die natürlichen Pflanzenfamilien 91: 89. 1893.
[4] Hep. Amaz. et And. 452. 1885.
[5] Musci Scand. 4. 1879.
[6] Bull. Torr. Bot. Club **6**: 85. 1876.

in the character of their leaf-margins; but the various forms may be at once distinguished from *P. interrupta* by their ascending habit, and from all our other species by their rotund or broadly ovate leaves with rounded apex. The leaves may be distant or imbricated, nearly plane or strikingly convex, obliquely spreading or deflexed, and their margins are entire, subentire or denticulate; in fact, several of these variations are often found on a single stem, the tendency in such a case being for the leaves to become more crowded and more toothed as the apex of the stem is approached.

The American forms with entire or subentire leaves were long ago separated from typical denticulate-leaved forms as a distinct species, *P. porelloides.* We find the first description of this plant (as *Jungermannia porelloides* Torrey) in the classical "Naturgeschichte der europäischen Lebermoose"[8] of Nees von Esenbeck, who had examined sterile specimens collected in New York. After comparing it with his *Jungermannia interrupta*, he states that it is more nearly related to *J. asplenioides*, differing in its "constantly entire, obovate-cuneate leaves with less reflexed dorsal margin." Dumortier does not enumerate it among his species of *Plagiochila*,[9] but Lindenberg both describes and figures it under this genus; it is also admitted into the Synopsis Hepaticarum, where, although it is placed next to *P. interrupta*, it is said to differ from *entire*-leaved forms of *P. asplenioides* in the gibbosity of its leaves, no other difference being stated. In all recent works on American hepaticology, *P. porelloides* finds a place and it has also been distributed in several exsiccatæ.

As early as 1849, however, Spruce doubted the validity of this species. In his valuable notes on the "Musci and Hepaticæ of the Pyrenees," he writes, "I have seen no specimens of *P. porelloides* which I can safely separate from *P. asplenioides.*"[10] Forty years afterwards Lindberg[11] reduced *P. porelloides* to a subspecies of *P. asplenioides* giving one European and two Asian stations for the plant, which had heretofore been regarded as peculiarly American. The most important point of distinction which he gives is in the shape of the perianth; in *P. porelloides* this is stated to be "ovate-rectangular, well rounded at the base," while in *P. asplenioides*, it is said

[8] **1:** 169. 1833.
[9] Rev. Jung. 14. 1835.
[10] Ann. and Mag. Nat. Hist. II. **4:** 105. 1849.
[11] Kongl. Sv. Vet. Ak. Hand. **23:** 34. 1889.

to be "obconic." I have found that the shape of the perianth depends to a large extent upon the presence or absence of fertilization. In Swedish specimens of *P. asplenioides* collected by Dr. Arnell, some of the perianths with unfertilized archegonia are distinctly rounded at the base, while in specimens of *P. porelloides* collected by Professor Underwood near Syracuse, New York, perianths with mature capsules are narrowed and subterete at the base. It is apparent, therefore, that Lindberg's point of distinction is of little real value. Dr. Schiffner[12] has already reduced *P. porelloides* to a simple synonym of *P. asplenioides*, and there seems to be no reason why we should not follow his example, particularly as forms of this species with entire or subentire leaves have long been recognized in Europe.

3. **Plagiochila Columbiana,** n. sp.—*Plate XV. figs. 1–10.*

Sterile, brownish or yellowish green, loosely caespitose; stems ascending, simple or pinnately branched, rarely dichotomous, often sparingly radiculose; leaves contiguous or imbricated, widely spreading, broadly orbicular-ovate, antical margin decurrent, revolute, entire or occasionally bearing an acute lobe-like tooth, postical margin rounded at the base, plane or rarely reflexed, entire or irregularly 1- to 3-toothed, apex broadly truncate, usually bearing a few scattered teeth; underleaves either minute and subulate or larger, lanceolate to ovate, acute, entire or irregularly toothed or lobed; leaf-cells polygonal, with thickened walls and prominent trigones.

Stems 1.5 to 3^{cm} long, 0.4^{mm} in diameter; leaves 1.6^{mm} long, 1.1^{mm} wide; leaf-cells from middle of leaf averaging 0.041^{mm} in diameter.

On boulders subject to inundation; Rock Creek, near Washington, D. C., J. M. Holzinger.

In general appearance *P. Columbiana* bears some resemblance to *P. asplenioides;* but, under the microscope, it may be at once distinguished from that species by the ragged outlines of its leaves and by the irregularity in the number and position of their teeth. The latter are frequently wanting in the lower leaves and they are always few in number; as a rule they are short and blunt but they are sometimes longer and become lobe-like in character. The leaf-cells of this species are much larger than those of *P. asplenioides* or of any other of our Plagiochilæ. The large underleaves described above

[12] Engler-Prantl, Die natürlichen Pflanzenfamilien 91: 89. 1893.

are quite unlike those commonly found in the genus. In some cases they attain a third the size of the leaves and their cells are very like the ordinary leaf-cells of the species. They are by no means frequent, occurring on about one out of every five stems examined, and it is rare to find more than one or two of them on a stem. When they do occur, however, they are persistent and may be found by the older, as well as by the younger leaves. It is to be hoped that fruiting specimens of *P. Columbiana* may soon be collected, as it would be of interest to learn whether or not these peculiar underleaves take part in the formation of the involucre.

4. PLAGIOCHILA VIRGINICA Evans in Millspaugh: Flora of West Virginia 497. *pl.* —. 1892.

Since the publication of this species, I have received from Professor Underwood specimens of the same plant, collected by himself near Washington, D. C., in 1891. They are a little more robust than those collected by Dr. Millspaugh and some of the stems show minute underleaves; otherwise the specimens agree closely.

5. **Plagiochila Floridana,** n. sp.—*Plate XV. figs. 11–17.*

Dioicous; loosely caespitose, yellowish or brownish green; stems simple or dichotomously branched; leaves imbricated, rectangular or ovate-rectangular, slightly convex, obliquely spreading, antical margin decurrent, straight or nearly so, entire, plane or subreflexed at the base, postical margin narrowly and abruptly long-decurrent, straight and parallel to the antical margin, or slightly curved, entire or usually irregularly dentate, apex broad and truncate, either irregularly and deeply spinose-dentate or bifid with a shallow sinus and distant acuminate lobes; leaf-cells polygonal with thickened walls and evident trigones; underleaves minute, subulate; ♀ inflorescence terminal, subtended by one or two innovations; bracts two, oblong, antical margin reflexed, entire in lower part, margins otherwise irregularly spinose; perianth (young) shorter than the bracts, broadly obovate, bilabiate with ciliate lips, wingless or narrowly winged; ♂ inflorescence not seen.

Stems 0.5 to 1.5^{cm} long, 0.12 to 0.25^{mm} in diameter; leaves 1.1^{mm} long, 0.4^{mm} wide; leaf-cells in middle of leaves, averaging 0.023^{mm} in diameter.

Mixed with Lejeuneæ on decaying logs; Ocala, Florida, L. M. Underwood. Distributed in Hep. Amer. *n. 109* as *P. Ludoviciana.*

This species differs from *P. Ludoviciana* in its smaller size, in its manner of branching, and in the shape of its leaves, which are not widened out and reflexed at the postical base and whose antical margins are not strongly arched. It is near *P. dubia* Lindenb. & Gottsche as figured by Gottsche,[13] but the leaves are more imbricated and more deeply toothed than he represents and the perianth has longer cilia.

6. **Plagiochila Sullivantii** Gottsche MS.—*Plate XV. figs. 18–21* and *XVI. figs. 1–3.*

P. spinulosa Sull. Musci Alleg. *n. 219* [not (Dicks.) Dum.].

Dioicous; growing in depressed tufts, glossy, bright green varying to yellowish green and becoming brownish with age; stems simple or sparingly branched; leaves distant or subimbricated, widely spreading, slightly convex, varying in shape from narrowly ovate to obovate, antical margin slightly decurrent, straight or a little curved, entire, subreflexed towards the base, postical margin short-decurrent, arched, usually entire at the base but soon becoming incised-dentate, apex broad, either coarsely dentate or bifid with pointed, entire or denticulate lobes; leaf-cells polygonal, thin-walled and scarcely thickened at the angles; underleaves minute, split to the base into several capillary lobes.

Stems 0.5 to 1.5^{cm} long, 0.2^{mm} in diameter; leaves 1.2^{mm} long, 0.5^{mm} wide; leaf-cells in middle of leaf 0.019^{mm} in diameter.

Banks of rivulets, Alleghany mountains, Sullivant. On shaded rocks; New Hampshire: White mountains, James; Connecticut: Beacon Falls, Evans; Branford, Eaton; Pennsylvania: Canadensis, Mrs. Britton; North Carolina, in Lindenberg herbarium. Distributed as *P. spinulosa* in Musci Alleg. *n. 219*, in Hep. Bor.-Amer. *n. 9*, and in Hep. Amer. *n. 111.*

Some years ago Mr. W. H. Pearson of Manchester, England, expressed the opinion that this species was distinct from the true *P. spinulosa*, and a comparison of the two soon convinced me that such was indeed the case. I had hoped to name the plant in Mr. Pearson's honor, but upon consulting the Gottsche herbarium, I found that it had already been named in manuscript by that author. In addition to the material distributed by Sullivant, Gottsche had examined a specimen from the Lindenberg herbarium (labeled *Jungermannia*

[13] Mex. Levermosser *pl. 2.* 1863.

sertularioides Michx.), upon which he had discovered perianths. I have failed to find these organs in any of the material at my disposal, so I add the following description from Gottsche's notes: "perianthio ovato-cylindrico semi exserto non alato, ore rotundo compresso, labiis dentatis; foliis involucralibus conformibus, appressis." Some of our forms differ considerably from Sullivant's specimens, which we must regard as the type of the species; but no good lines of distinction can be drawn between them, as intermediate forms also occur.

The true *P. spinulosa* is a European species occurring in Great Britain and, more sparingly, in the western parts of the continent. It is extremely variable, but its numerous forms all agree in the characters of their leaf-cells, which have thick walls and strongly developed trigones, in marked contrast to the thin-walled cells of *P. Sullivantii*. It also differs from our species in its larger size and in its broadly ovate or obovate leaves, which are strongly arched over the stem at the postical base. Among our own Plagiochilæ, *P. Virginica* and *P. Floridana* bear some resemblance to *P. Sullivantii*. The former differs in its pale, dull color, in its broader leaves with shorter and more inconspicuous teeth and its slightly larger leaf-cells; the latter in the shape of its more obliquely spreading leaves and in its leaf-cells which have thicker walls and better developed trigones.

7. PLAGIOCHILA LUDOVICIANA Sull. Musci Alleg. *n. 223.* 1845: Amer. Journ. Sci. and Arts II. **1**: 73. 1846.—*Plate XVI. figs. 4–12.*

Stems 2 to 4^{cm} long, 0.2 to 0.3^{mm} in diameter; leaves 2.5^{mm} long, 1.2^{mm} wide; leaf-cells with slightly thickened walls and well developed trigones, in the middle of the leaf averaging 0.029^{mm} in length by 0.021^{mm} in width.

In this species the underleaves are of two forms: in the one, they are of delicate texture and are deeply split into slender laciniæ; in the other, they are leaf-like in texture and are either bifid or irregularly cleft with entire or toothed margins. The latter form is apparently confined to robust plants. Sullivant says that the ♀ inflorescence is terminal, but does not describe the floral organs. In the examination of a large number of specimens, I failed to find either kind of inflorescence. Many of the plants examined reproduced themselves vegetatively by means of the propagula, which have been

well described for the genus in general by Spruce.[14] They are minute stems springing from the leaf-cells and bearing distant bifid leaves; in some cases they are very numerous and almost cover the surfaces of the leaves from which they spring. Similar propagula are sometimes found in *P. Floridana* and possibly in our other species.

8. PLAGIOCHILA UNDATA Sull. Musci Alleg. *n 222.* 1845: Amer. Jour. Sci. and Arts II. **1**: 73. 1846.—*Plate XVI. figs. 13–19.*

P. crispata Gottsche? Mex. Levermosser 71. *pl. 15.* 1863.

Stems 2 to 3^{cm} long, 0.2 to 0.3^{mm} in diameter; leaves 1.9^{mm} long, 0.8^{mm} wide; leaf cells with thickened walls and well developed trigones, in the middle of the leaf averaging 0.020^{mm} in diameter.

Like the preceding species, *P. undata* is usually sterile. I have examined a single imperfect perianth from specimens collected by Professor Underwood at Toccoa Falls, Georgia, and append a description of it and its bracts: perianth terminal, subtended by 2 innovations, 2^{mm} long by 2^{mm} wide, flattened, campanulate, bilabiate with ciliate lips; bracts two, 1.7^{mm} long and 2.6^{mm} wide, broadly cuneate, antical margin reflexed, denticulate, postical margin and apex irregularly dentate.

The Mexican *P. crispata* is with some doubt referred to this species. If Gottsche's figures are compared with those of *P. undata*, it will be seen that, although at first sight they are apparently unlike, the differences are of degree, rather than of kind. In *P. crispata*, the leaves are more strongly repand-undulate along the postical margin than in our species. The specimens of *P. undata*, however, which were collected by Rev. A. B. Langlois at Chinchuba, Louisiana, and distributed as no. 152 of "Hepaticæ Americanæ," show both extremes in this regard and seem to break down the distinction between the two species. Both *P. Ludoviciana* and *P. undata* are rather widely distributed in our Gulf states.

In conclusion I would express my thanks to Professor Underwood, who has loaned me his valuable collection of Plagiochilæ; to Mr. Pearson, who has given me permission to use his drawing of *P. Sullivantii;* and to Professor Schumann, who has allowed me access to the Gottsche herbarium, now preserved in the Botanical Museum at Berlin.

Yale University.

[14] Hep. Amaz. et And. 452. 1885.

Explanation of Plates XV and XVI.

Plate XV.

Plagiochila Columbiana Evans.—Fig. 1. Plants, natural size.—Fig. 2. Part of stem, antical view (× 6).—Fig. 3. Part of stem, postical view (× 6).—Fig. 4. Underleaf, small, normal form (× 32).—Figs. 5–9. Underleaves, larger form (× 12).—Fig. 10. Cells from middle of leaf (× 200).

Plagiochila Floridana Evans.—Fig. 11. Plant, natural size.—Fig. 12. Part of stem, antical view (× 12).—Fig. 13. Part of stem, postical view (× 12).—Figs. 14, 15. ♀ bracts (× 12).—Fig. 16. Young perianth (× 12).—Fig. 17. Cells from middle of leaf (× 200).

Plagiochila Sullivantii Gottsche.—Fig. 18. Plants, natural size.—Fig. 19. Part of stem, postical view (× 12).—Fig. 20. Part of stem, antical view.—Fig. 21. Cells from middle of leaf (× 200).

Fig. 19, from Musci Alleg. *n. 219;* fig. 20, from Hep. Bor. Amer. *n. 9*, after a drawing by W. H. Pearson; figs. 18 and 21, from Connecticut specimens, collected by the author.

Plate XVI.

Plagiochila Sullivantii Gottsche (cont.).—Figs. 1, 2. Parts of stems, postical view (× 12).—Fig. 3. Underleaf (× 32).

Figs. 1 and 3, from Connecticut specimens, collected by the author; Fig. 2, from Pennsylvania specimens collected by Mrs. Britton.

Plagiochila Ludoviciana Sull.—Fig. 4. Plant, natural size.—Fig. 5. Part of stem, antical view (× 12).—Fig. 6. Part of stem, postical view (× 12).—Fig. 7. Underleaf, small, normal form (× 32).—Figs. 8–10. Underleaves, larger form (× 32).—Fig. 11. Cells from middle of leaf (× 200).—Fig. 12. Part of leaf, showing propagula (× 32).

Figs. 4, 8–11, from Louisiana specimens, collected by Langlois; figs. 5–7, 12, from Florida specimens, collected by Lighthipe.

Plagiochila undata Sull.—Fig. 13. Plant, natural size.—Fig. 14. Part of stem, antical view (× 12).—Fig. 15. Part of stem, postical view (× 12).—Fig. 16. Leaf, postical view (× 32).—Fig. 17. Leaf, lateral view (× 32).—Fig. 18. Underleaf, lateral view (× 32).—Fig. 19. Cells from middle of leaf (× 200). All figures from Hep. Amer. *n. 108.*

A simple freezing device.

WINTHROP JOHN VAN LEUVIN OSTERHOUT.

The apparatus consists of a freezing chamber upon which the object is frozen, and two pails filled with ice and salt. The pails are so arranged that when either of them is raised the other is lowered, and in consequence, the cold brine, which forms as the ice melts, can be made to flow back and forth through the freezing chamber which is between the pails and connected with them by rubber tubing.

The freezing chamber is a hollow cylinder made of brass or of iron, nickel-plated both inside and outside. Fig. 1 shows a section of the chamber, actual size. The brine enters one of the tubes at the side and escapes by means of the other. Below the bottom of the chamber, *D*, the cylinder is furnished with a thread inside, by means of which a wooden plug, *C*, is screwed firmly against the bottom of the chamber. The wooden plug is held securely in the jaws of the microtome and prevents the conduction of too much heat from the latter to the freezing chamber.

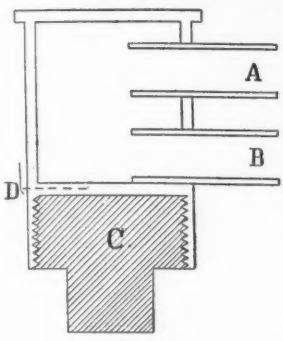


FIG. 1.

Large pails holding about five gallons are most convenient, since they contain ice enough to run the apparatus all day without being refilled. Smaller pails are just as serviceable if the apparatus is to be used for a short time only. Paper pails are best for the purpose, but ordinary wooden ones can be used. Each pail should be provided with a faucet capable of delivering a stream of water one-quarter of an inch in diameter; the faucet should be inserted about an inch from the bottom of the pail. The paper ice-water pails in common use answer the purpose perfectly.

In order to prevent the dirt, straw, etc., which usually adheres to the ice, from passing into the freezing chamber a piece of coarse wire netting should be bent into the form of

a hollow cylinder six inches long and four in diameter. The cylinder should then be stuffed with excelsior, and one end of a piece of glass tubing pushed into the center of the mass; the free end of the tube should then be connected with the faucet on the inside of the pail by a short rubber tube. The brine is then forced to filter through the tightly packed excelsior before entering the tube.

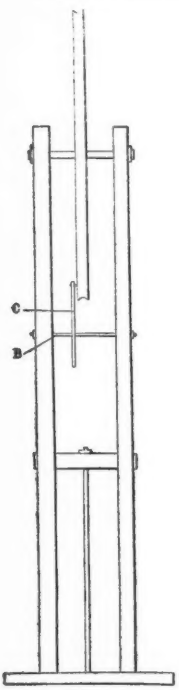


FIG. 2.

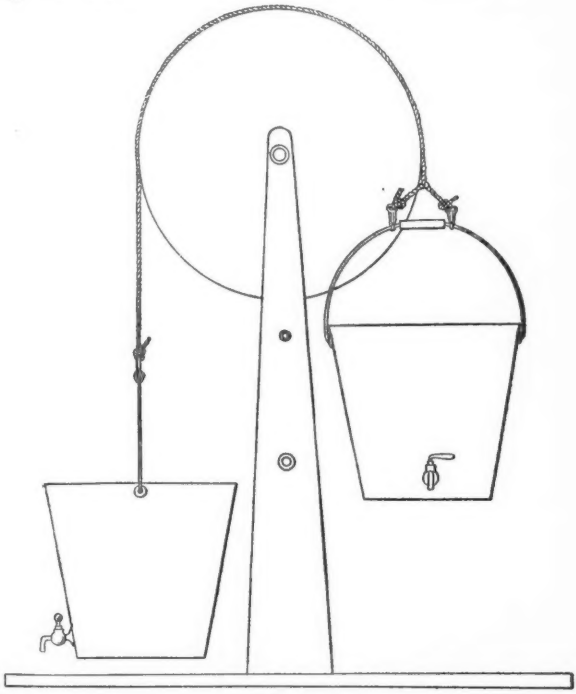


FIG. 3.

The standard upon which the pails hang is constructed of wood. It can best be understood by a reference to figures 2 and 3. Both figures are one-twelfth actual size. Figure 3 shows a side view of the standard. The diameter of the wooden wheel must be great enough to prevent the pails from striking the upright piece as they rise and fall. The rope which passes over the wheel is secured at its middle point by a nail driven through it into the wheel; the pails are fastened

to the rope by ordinary metal "snaps," so that they can be instantly detached or put on. The rope should be of such length that when the bottom of one pail is about level with the top of the other the bottom of the latter hangs an inch and one-half above the base of the standard.

The construction of the upright piece is evident from figure 2, which shows an end view of the apparatus. The two upright pieces are held together by a wooden cross-piece, from which a stout metal rod runs to the base; the axle of the wheel also aids in holding the two pieces together.

An automatic catch serves to retain the pails in the position shown in figure 3. Figures 4 and 5 show this contrivance in flat view, one-half actual size. It is made of sheet iron, one-quarter of an inch in thickness. The small hole at the top is for the screw which fastens it to the wheel. It has a single continuous slot, *D*, in which are two notches, *F* and *F;* the outlines of the slot and notches are dotted in the figures. A thin strip of copper, one inch wider than the sheet-iron strip, is placed upon the latter, and its edges bent around the iron strip so as to partially surround it. It is thus able to slide freely upon the iron strip, but it should not fit loosely enough to slide of its own weight when in an upright position. The copper strip, which is shaded in the figures, has a slot, *E*, which in its narrowest part has the same diameter as *D*, over which it fits exactly.

The metal rod *B* (see fig. 2) is made to pass through the middle of both uprights and through the slots *D* and *E*, in which it must be small enough to slide freely. The strip *C* is then secured to the wheel by a screw passing through the hole at the top. The screw should be small enough to permit the strip to swing freely. The strip is fastened to the wheel in such a way that when the wheel is turned so as to bring both pails on a level, the strip is vertical. It should be fixed

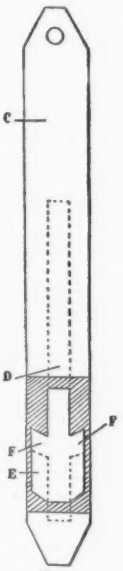


FIG. 4.

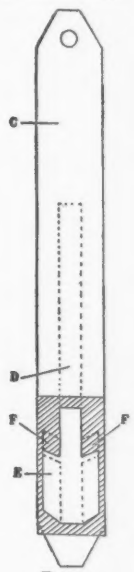


FIG. 5.

at such a height that when the pails are in the position shown in fig. 1, the metal rod, *B*, slips into the notch *F*, (fig. 4).

The weight of the upper pail (which is the heavier when the apparatus is in use) retains the rod in this position. The copper strip now has the position shown in figure 4. As the brine flows from the upper pail into the lower, the latter (which hangs one and one-half inches from the base of the standard), becomes the heavier and settles slowly down till it rests on the base. This causes the wheel to turn and the rod *B* (fig. 2) travels to the bottom of the slot *D* (fig. 5) carrying with it the copper strip, which takes up the position shown in fig. 5. When all the brine has passed into the lower pail the latter should be raised. As the pail raises the wheel turns and the rod *B* travels upward in the slot *D*, but passes over the notch *F*, which is now covered by the copper strip. It continues to travel upward, carrying the copper strip with it until the iron strip *C* reaches a vertical position. As the wheel continues to turn the rod *B* begins to descend in the slot *D* until it again drops into the notch *F*. As the heavier pail is now uppermost it must remain so until the lower pail becomes heavier, when the process is repeated. This very simple piece of apparatus answers its purpose perfectly, is easily made and cannot get out of order.

In order to use the apparatus both pails are filled with cracked ice and coarse salt in alternating layers, the cylinder containing excelsior resting on the bottom of the pail.

The freezing chamber is clamped into the jaws of the microtome which touch only the wooden plug. Care should be taken that the metal part of the chamber does not touch the microtome as otherwise heat will be conducted to the freezing chamber and freezing will be more difficult. The standard is then placed on the table at the left of the microtome, with the end facing the front of the table. The pails are then attached and made to assume the position shown in figure 3. The tubes of the freezing chamber should project at the left and be connected, one with each faucet by rubber tubing. A cold brine soon forms which flows through the freezing chamber and almost instantly freezes the material placed on the top of the chamber. By means of the faucets the flow of brine may be regulated, and this in turn regulates the temperature of the chamber.

As soon as the brine has all run into the lower pail the po-

sition of the two pails should be reversed. The person using the microtome does not need to rise from his chair to accomplish this, since he can easily reach the pail nearest him and raise or lower it as necessity requires. The weight to be lifted is simply the weight of the brine, since the weights of the two pails with their content of ice and salt balance each other. The shifting of the pails therefore occupies only the left hand, leaving the right free. The falling of the lower pail indicates that most of the brine has run through. If a more accurate indication is needed one may insert in one of the rubber tubes a glass T-tube with a cork at the top of the free arm of the tube. A black feather may be fixed to the cork in such a way that the end dips in the current and shows by its deflection the direction and force of the flow. When too much brine has accumulated the temperature rises and freezing proceeds too slowly; a part must then be siphoned off. Usually this happens once, or at most twice, during the course of one day's use of the apparatus. The addition of more ice is very seldom necessary.

If the operation of freezing is interrupted for less than half or three-quarters of an hour the faucets should be nearly closed. Objects already frozen will remain so under these conditions as long as the brine continues to flow. If the apparatus is to be left for a longer time the brine should all be drawn off and thrown away, and the faucets closed. A moment's flow will render the apparatus ready for use again.

During a year's test in cutting both plant and animal tissues this apparatus has proven entirely satisfactory. Its principal advantages are as follows:

1. It is simple, inexpensive and cannot get out of order.

2. The material cannot alternately thaw and freeze (as is the case when it is frozen by the ether or carbonic-acid-gas method), but remains at a constant temperature and of uniform consistency.

3. The danger of over-freezing, which has proved a serious defect in the carbonic-acid-gas method, is entirely obviated. On the other hand, no difficulty is experienced in freezing, as is often the case with the ether method.

4. It can be applied to any microtome which has a horizontal movement of knife or object carrier. In most cases no previous embedding is necessary but fresh material, or that which is preserved in aqueous media, may be placed in a syrupy

solution of gum arabic[1] and frozen at once. Tissues sectioned in this way are practically unaltered. Delicate tissues and those containing large air cavities can be sectioned with the greatest ease. The damage wrought in many tissues by dehydration are entirely obviated by the freezing method.

Frozen sections may be mounted in glycerin jelly or any aqueous medium. If mounted in glycerin, it will be found convenient to ring the cover with a thick solution of gum arabic. A glycerin-gum is then formed around the edge of the cover and in a short time is dry and hard on the outside. A ring of Canada balsam or cement may then be applied and the mount is as permanent as it is possible to make a glycerin mount. Frozen sections may be fixed to the slide for staining purposes by Fol's method (see Lee; Microtomist's Vade-Mecum, 218, 1893).

When delicate parts are present, such as spores, etc., which are apt to fall out of the section, the following method can be used with entire success.

A gelatin solution is made as follows: The best gold label gelatin is selected and carefully brushed clean and made up according to the following formula: gelatin, 32 parts; distilled water, 48 parts; carbolic acid, 1 part. Dissolve the gelatin in a closed vessel over a water bath; add the carbolic acid and mix until it is thoroughly dissolved, and then add the white of one egg to clarify.[2]

The object to be cut is placed for a short time in the melted gelatin and quickly washed in warm water (about 90° Fahr.) to remove the gelatin from the outside. It is then placed at once in water at room temperature. This sets the gelatin with which the object is now infiltrated, and the latter may be sectioned at once in gum arabic or preserved in two per cent. formalin until needed. If sections cut in this way are placed on a slide and a little glycerin added over a water bath, a glycerin jelly is formed and the addition of a cover and a ring of cement completes the process. If the sections are taken from the knife in the gum in which they are cut and placed at once on the slide and subjected to the process just mentioned, a glycerin-jelly-gum is formed which makes an excellent mounting medium.

A simpler form of the above apparatus is shown in figure

[1] As some of the preservatives ordinarily added to gum arabic attack the knife, formalin is recommended for this purpose.

[2] For this formula I am indebted to Mr. N. N. Mason of Providence, R. I.

6.[3] The larger pail is filled with ice and salt and the smaller one catches the brine which is poured back into the larger pail. A stop-cock at the lower pail regulates the flow; the former is fastened to the pail by a wooden clothes pin.

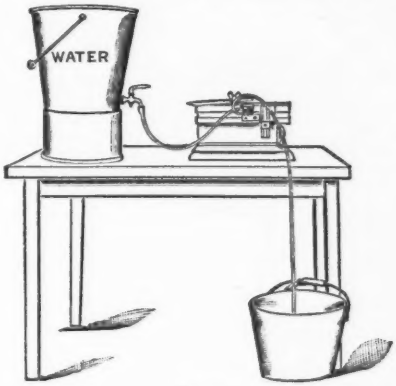


FIG. 6.

An inexpensive substitute for this form of the apparatus may be quickly made. A large wooden pail may be bored near the bottom, a cork inserted and pierced by a glass tube. A piece of brass pipe, one inch in diameter, with a thread at the end may be sawed off an inch and a half from the end and converted into a freezing chamber by soldering in the brass discs and inserting two straight tubes at the side. A glass tube drawn to the required aperture may be used in the place of the stop-cock at the lower pail and other tubes of different apertures may be quickly substituted.

Providence, R. I.

[3]For the use of this cut I am indebted to the courtesy of the Bausch & Lomb Optical Co., Rochester, N. Y.

Notes on some North American species of Parmelia.

HENRY WILLEY.

The large lichen genus Parmelia presents many difficulties from the variability of its forms, and with regard to the chemical reactions of the thallus with liquid potassa (K) and hypochlorite of lime (CaCl) either separately or combined. As Tuckerman has remarked, it tends to develop into evernioid forms, of which the extreme is manifested in P. Kamtschadalis and P. cervicornis, and this tendency is manifested in species of the stock of P. perforata. Some writers have placed Evernia furfuracea in Parmelia. As to the chemical relations I am unable to attach absolute specific value to them. There are exceptions to their constancy, some of which were pointed out by Tuckerman in a paper in the *American Naturalist* for 1868, which remain to be accounted for. I have recently collected two specimens of Parmelia on the same trunk, one of which gave a positive (red) reaction with K, and the other a negative one, while otherwise there was not the slightest difference between them. So I have collected at the same time on red maple, two specimens of Buellia parasema in one of which the thallus gave a yellow reaction with K, while in the other the yellow immediately turned to red. But all the difference between them was that the former seemed to be the younger of the two. Specimens gathered at other times yielded no reaction. The cladonias also present similar difficulties. It is possible that a lichen may possess different chemical constituents at different stages of growth, or under different conditions of soil, climate, etc. Experiment on the same plant at different periods of its development is necessary to confirm the deductions from simple examination. Still, the reactions appear to be constant in most of the species of Parmelia and may serve as an aid in their determination, while the exceptions remain to be accounted for. Where there appears to be an exception we may best say that "perhaps" the specimen belongs to a distinct species.

Tuckerman, whose views in regard to species were very conservative, described in his *Synopsis* nineteen species of Parmelia. Some of his varieties are regarded by other authors, either on chemical or other grounds, as distinct species. Ny-

lander[1] described ten North American species, and has discovered some new ones among specimens sent him from New Bedford; and some additional species have turned up since Tuckerman wrote. So that at present there appear to be known about forty species. The reactions of most of the species are given in Hue's *Lichenes Exotici*.

1. P. PERLATA (L.) Ach.—Th. K yellow Me. K—. But in the var. *olivetorum* Ach. (the proper designation of which seems to be *olivaria* Ach.) Me. K dull red. The lichen is a widely extended one. Very near to it is *P. cetrarioides* (Del.) Nyl., which occurs on rocks in New Bedford, agreeing with a specimen from Switzerland (Lojka.). Another New Bedford specimen, with the habit and reaction of perlata, has the lobes ciliate, and may be the var. *ciliata* DC. But Nylander[2] considered it hardly to differ from *P. crinita*. A sorediate form (var. *sorediata* Schær.) also occurs in New Bedford.

2. P. CRINITA Ach.—The New Bedford plant referred here in Willey's *Lichens of New Bedford* is referred by Nylander to *P. perforata*. But I have since found an isidiose specimen, otherwise resembling *P. perlata*, which may be the plant of Acharius and of Tuckerman's *Synopsis* which is so described. The reactions of P. crinita are variously described by authors as Me., "saftgrün" (Krempelhuber), "atro-virens fere atra" (ibid.). The *P. crinita* Nyl. Syn. seems to be a different plant, and is referred by Wainio (Brazil) partly to *P. proboscidea* Tayl. and partly to *P. melanothrix* (Mont.). P. crinita is mentioned in several lists of North American lichens, but on what authority I know not.

3. P. CETRATA Ach.—This, like the preceding, is a difficult lichen. Tuckerman seems to have regarded all forms of the stock of perforata with narrowed or finally evernioid lobes as belonging here. But I think this can hardly be the case. *P. perforata* var. *cetrata* from Australia (Müller) gives Me. K—. A remarkable variety is var. *hypotropoides* Nyl. in litt., growing on branches of red cedar at New Bedford, with the thallus underneath white, as in *P. hypotropa*, and becoming yellow with K. Wainio (Brazil) gives the reaction of cetrata Th. K yellow, Me. K yellow, then red, with which the New Bedford plant agrees. A large New Bedford plant called *P. cetrata* by Tuckerman, is referred by Nylander to *P. tiliacea*, of which

[1] Flora —: 605 *et seq.* 1885.
[2] Flora —: 608. 1885.

it has the lobation, but much larger spores, while it agrees with tiliacea in its closely appressed habit. The plants called cetrata in lists of North American lichens must be considered as doubtful.

4. P. TINCTORUM Despr., Nyl. Pyr. Or. 16.—This plant, according to Wainio, Brazil, has received various names and is *P. perlata* var. *coralloidea* Mey. & Flot., *P. praetervisa* Müller and *P. perlata* var. *platyloba* ibid: to which he unnecessarily adds another, *P. coralloidea.* A specimen from Jamaica (Rev. F. Wolle) determined by Nylander has the thallus prolonged into convolute lobes; and a specimen from the west coast, H. A. Green, resembles var. *platyloba.* All the specimens give the same reaction Me. CaCl red.

5. P. SACCATILOBA Tayl. Nyl. Flora —: 608. 1885. Pyr. Or. 40. (*P. latissima* Kph.; *P. Zollingeri* Hepp.)—Me. K yellow, CaCl light red. Spores large, nearly as in *P. latissima* Fée.—Mexico. *P. glaberrima* Kph. is *P. latissima* Fée.

6. P. COMPARATA Nyl. Flora—:290. 1869 where it is said to be perhaps a var. of perlata analogous to cetrata, with the aspect of laevigata, is said in Hue Exot. to be widely distributed in North America. Me. K yellow.

7. P. SUBMARGINALIS Mich. Nyl. Flora —: 607. 1885.—(*P. perlata* Mont. Cub. 230; *P. perforata* var. *cetrata* Müller Beitr. *n. 69; P. perlata* var. *ciliata* ibid. *n. 1639*). "Similar to *P. perlata,* but the margin of the thallus ciliate and often partly laciniate, or laciniose-fimbriate. Apothecia larger, often perforate. Spores .014–018 × .008–.012^{mm}." Nyl. l. c. Me. K—. In a New Bedford specimen the thallus is divided into long, narrow, convex laciniæ, which are black and naked beneath. Another old and rigid specimen was called *P. subrugata* in Willey: Lichens of New Bedford, but the prolonged lobes are broader.—In *P. perlata* the spermatia are bifusiform, .005^{mm} long; in *P. submarginalis,* acicular .008–.010^{mm} long, and in *P. perforata* acicular-cylindrical, .010–.016^{mm} long.

8. P. HYPOTROPA Nyl.—This species is distinguished by the white borders of the under side of the thallus, which are colored yellow then red by K. Reaction as in *P. perforata,* Me. K yellow, then red.

9. P. HYPOTROPOIDES Nyl. in litt.—Thallus expanded, membranaceous, glaucescent, the rounded lobes depressed, more or less crenate, and finally elongated into narrow flat

laciniæ, beneath black and naked, but yellowish-white at the margin. Me. K red, but not showing any reaction beneath. Apothecia large, perforate. Spores .009–.16 × .006–.009^{mm}.—On trees, New Bedford, and District of Columbia (Lehnert).

10. P. PRÆSIGNIS Nyl. Pyr. Or. 17; Flora —: 610. 1895. On trees, Arizona, Pringle, 1881. Me. CaCl red. Spores .014—.016 × .007—.009^{mm}; spermatia bifusiform, .006—.007^{mm} long. Also in Mexico.

11. P. TILIACEA Ach.—The reaction given is Me. CaCl red, as in Lojka Exsic. Univ. *n. 62.* But only one of numerous specimens gives any reaction, which would be *P. sublævigata* Nyl. Me. K yellow, then red.—*P. livida* Tayl. from New Orleans is considered by Nylander as a variety of this; but Müller in Beitr. *n. 1344* looks upon it as distinct. *P. galbina* Ach. Syn. 195, from North America is a small form on dead wood. *P. relicina* Fr., which is made a variety of this by Tuckerman, is considered by most authors to be distinct.

11. P. BORRERI, var. RUDECTA Tuck. is separated by Nylander on account of the spermatia which in Borreri are sublageniform and in rudecta acicular-cylindrical and twice as long.

12. P. KAMTSCHADALIS (Ach.) Eschw. Me. K red.—"*Borrera glabrata* Schwein." then "*Evernia polita* Tuck." in herb. Schwein. (comm. Eckfeldt without station) seems to be a broad-lobed form of this.

13. P. CONSPERSA (Ehrh.) Ach.—Me. K yellow then red. But isidiose specimens on rocks, New Bedford, give Me. K—. as is also the case with a similar specimen in Stenh's Exs. Suec. *n. 122*, while the others give K red.

14. P. MOLLIUSCULA Ach.—Me. K yellow, then red. Mr. T. A Williams has described and figured in Report of Missouri Bot. Garden, May 1892, a fertile specimen collected in the Black Hills by Dr. Engelmann in 1856. A fertile plant, collected by T. S. Brandegee in Colorado, closely resembles Mr. Williams's figure and description. Apothecia numerous, the margin incurved, crenate, the disk blackening. Spores .011–.013 × .005–.006^{mm}. Spermatia cylindrical, .007–.009^{mm} long. Me. K red.

15. P. CONGRUENS Ach.—This species, which is figured in Swartz, Lichenes Americani, *pl. 4*, was not recognized by Tuckerman as North American. But according to Nylander it occurs in Mexico, and Müller, who had seen Muhlenberg's

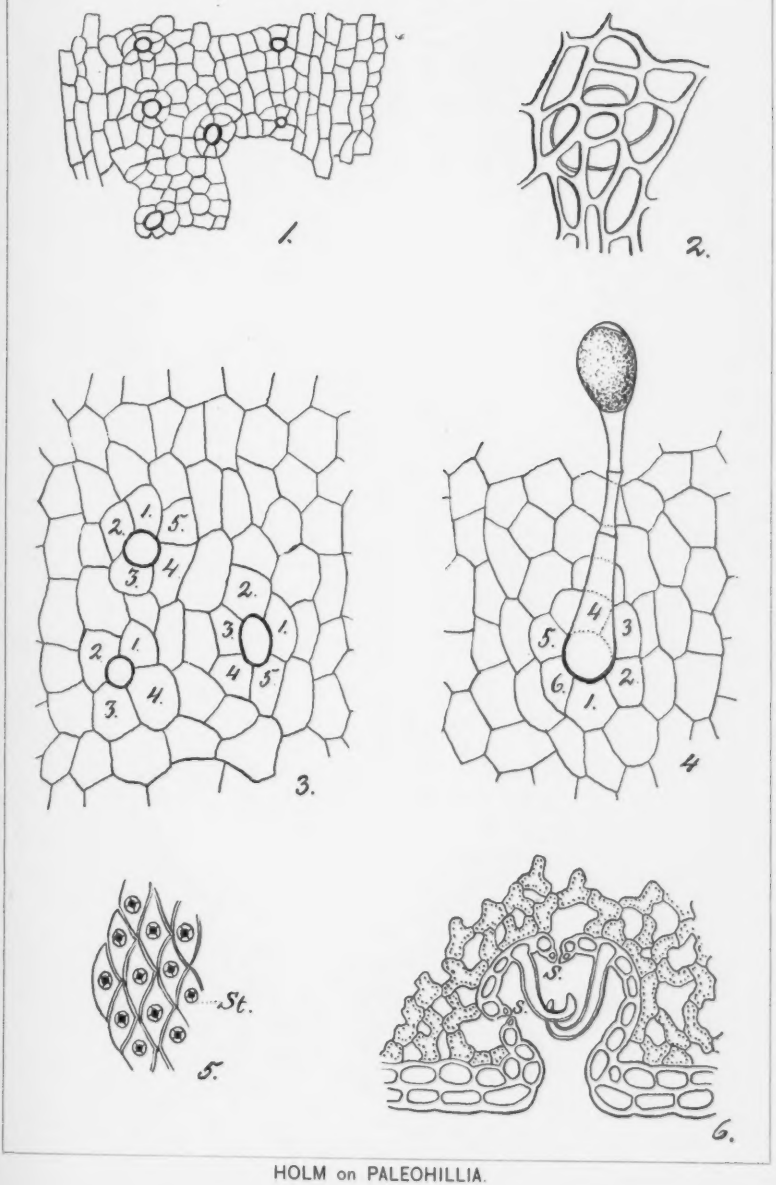
original specimen in herb. Swartz says in Lich. Argent. 64 that he cannot distinguish it from his *P. versicolor* Beitr. *n. 315*, from New Holland, and refers Krempelhuber's plant to a distinct species, *P. subcongruens*.

16. P. ISIDIOCERA Nyl. Syn. **1**: 382.—This occurs in arctic America. "Affinis *P. aurulenta*."

17. P. SPHÆROSPORELLA Müller Beitr. *n. 1650*.—Thallus appressed ochroleucous, rugose beneath, pale yellowish, and with pale fibrils. Apothecia at length plane, the disk from flesh-colored becoming livid-fuscous. Spores globose, diam. .005–.007^{mm}.—On trees, Oregon, Dr. Lyall, in herb. Kew.

18. P. ACETABULUM, Me. K yellow then red, occurs in arctic America. Most of the Parmelias of the brown series give no reaction.

New Bedford, Mass.



HOLM on PALEOHILLIA.

Remarks upon Paleohillia, a problematic fossil plant.

THEO. HOLM.

WITH PLATE XVII.

This genus has lately been established by Mr. F. H. Knowlton, and the description has been published in the *Bulletin* of the Torrey Botanical Club.[1]

It is always interesting to learn something about the structure of fossil plants, especially since their manner of preservation very often renders their microscopical examination exceedingly difficult. But even when the preservation permits a closer examination, so that the tissues may be easily observed, we then meet with the difficulty of parallelizing the structure with that of the plants known. It then depends upon the investigator himself whether he is able to point out anatomical characteristics which are sufficient for the classification of the plant in question. If no such conclusion can be reached and especially if we can not even ascertain the character of the fragment, whether it be a stem, a leaf, or a root, we do not feel justified in giving any further record of the specimen, except stating the fact that plants have occurred in the stratum, where the relics were found. We, therefore, do not think it advisable to establish anything like a family or a genus upon such defective fragments, and we take the opportunity to discuss the question in a rather general but comparative way.

The genus *Paleohillia* has been established upon some fragments, said to be hollow stems, the diameter of which is from 5 to 7.5^{cm}, the length of the specimens being several centimeters. The epidermis is described as consisting of elongated and shorter more irregular cells, and the stomata are said to have from four to six guard-cells. The accompanying plate shows a part of Mr. Knowlton's figure (fig. 1) of the epidermis, and we have, also, copied his drawing of a stoma (fig. 2), magnified 300 times.

The first question is now to decide whether the epidermis shows anything so characteristic as to enable us to determine whether the fragment really represents a stem. Considered

[1] **22**: 387-90. 1895.

by themselves the epidermis cells do not give us any hint in this direction, except that they seem to differ from those of an ordinary root. The fact that the cells are different in size and shape, viz., that there are bands of elongated cells in alternation with other bands of shorter, more irregular ones, only indicates that the elongated cells may have been situated above some fibro-vascular bundles. This is a very general feature of the mono- and dicotyledonous plants, and such structure is also known from the cryptogams. But whether it is a stem or a leaf can not yet be made out.

The next question is as to the nature of the stomata. Mr. Knowlton states that "these are the most remarkable feature of the plant, because the guardian-cells [*sic*] are quite irregular in shape and appear to vary in number from four to six." It is true that the number of guard-cells about a stoma is not always limited to two, and that the stomata of Equisetum and Marchantia have more. But as such stomata are entirely different from those figured by Mr. Knowlton, we have copied an illustration of the epidermis with stomata of Marchantia (fig. 5), taken from Sachs.[2]

Mr. Knowlton also states that the "guardian-cells are of course below the epidermal-cells." Combining now the facts in the structure of the stoma of Paleohillia we have seen that the number of guard-cells is not constant and that the stoma is situated below the epidermis. We will compare this description with Mr. Knowlton's drawing (fig. 2) and with our figure 6, which we have copied from Van Tieghem.[3] Our copy shows only a part of the original illustration so as to give the aspect of the stomata of *Nerium Oleander*. The stomata (*S* in the figure) are in this plant situated in cavities (cryptes stomatifères) below the surface of the leaf, and surrounded by the pneumatic tissue. But we fail to find any resemblance between these two figures, and we begin to doubt that Mr. Knowlton really has observed any true stomata.

We will return to his first figure (fig. 1) and consider again the openings, which should contain the stomata. We see then some roundish openings (if not cells?), which are surrounded by four or six cells, a structure that is very familiar

[2] Sachs, Julius: Vorlesungen über Pflanzen-Physiologie 83. *fig. 65 D.* Leipzig 1882.

[3] Van Tieghem, Ph.: Traité de Botanique 60. *fig. 33.* Paris. 1884.

to us. Cells of that shape and arranged in that manner remind us much of the basal cells of many vegetable hairs, and the resemblance is, indeed, very striking. We have examined a number of hairy plants, and found exactly the same structure. Fig. 3 is for instance the epidermis of a dead stem of the common garden pelargonium, where the hairs have dropped, leaving only the basal cells, which are, however, sufficient to indicate their place. Our next figure (fig. 4) represents also the epidermis of the same plant, but this has been taken from a living stem with the glandular hairs still attached, one of which has been figured. The aspect of this epidermis with the varying number of cells surrounding the base of the hairs does not seem to differ in any respect from the figure of Paleohillia given by Mr. Knowlton. And if we now add that bands of elongated cells are also observable in Pelargonium, we feel justified to state that the epidermis itself does not give any characteristic whatever so as to lead us to any conclusion.

What we have shown to be the epidermal structure of Pelargonium agrees, also, with the stem and leaf of many other plants of widely different families, so that there is no marked characteristic in the epidermis of Paleohillia. The fragments of this plant may just as well represent a closed sheath or a terete leaf as a stem, and so far the material seems too poor for the establishment of a new genus with "anomalous structure."

Washington, D. C., October, 1895.

Explanation of Plate XVII.

Fig. 1. Epidermis of Paleohillia.—Fig. 2. Stoma of same.—Fig. 3. Epidermis of a dead stem of Pelargonium. × 500.—Fig. 4. Epidermis of a living stem of same. × 500.—Fig. 5. Epidermis of Marchantia.—Fig. 6. Epidermis of Nerium Oleander, transverse section.

Notes from my herbarium. V.

WALTER DEANE.

My seedling collection.

As the spring of 1895 opened and the first delicate green began to appear, I found myself considering how I should add to my herbarium. All the plants that I might collect in the vicinity of Cambridge were already represented in my collection in flower, fruit, root and seed, and it seemed at first as if I must wait till the summer vacation might give me an opportunity of visiting some fresh locality. I was strolling one day over a bit of waste land, watching the little plants pushing their tiny heads above the ground, and thinking how impossible it was for me to name a single one of them in that early stage of their growth, when suddenly it occurred to me to make a collection of seedlings. Why shouldn't they have a place and an important place, too, in an herbarium? They are the beginning, the promise of the future plant, and yet we pass them by and refuse to recognize them. Then it would be interesting to compare these early forms with the full-grown plants and to see how the leaves in the two cases resembled each other. So I decided then and there to make a collection of as many seedlings as I could. This I did, and during the months of May, June and July I was engaged in as fascinating a piece of work as I have ever done in a botanical way.

My principal collecting grounds in Cambridge were of three kinds, waste land such as produces the ordinary garden weeds, a bit of bog frequented only by the botanist, and a salt marsh. My baby press and collecting box were constant companions and they never did better service. When I found a patch of seedlings, I collected a number of them carefully, and if they were small enough, as was generally the case, they went right into the little press. I then marked the spot in some way for future visits, and in the case of some species I made as many as half a dozen trips to the same patch, taking away specimens each time, for I wanted the collection to show the species from the seedling to the full grown plant, or at least to an identifiable form, all collected from the same spot. Some-

times the little fellows would betray their names very soon, and again I would wonder and wonder before I could compel the reluctant plant to reveal itself. Patience, however, always brought its reward.

There are difficulties, nevertheless, that are sometimes insuperable. A drought may dry up the precious spot after weeks of careful watching. In one instance I watered constantly a patch of weeds which I was afraid would not reach maturity, and I was rewarded with fine specimens. Cattle may crop the cherished plants just as you are expecting good returns for your care. I had collected seedlings of a Polygonum. The plants were advanced enough to show that they were either *Polygonum Convolvulus* L., the black bindweed, or *P. dumetorum* L., var. *scandens* Gray, the climbing false buckwheat. I wanted to see the calyx lobes, but when I visited the spot at the right time for fruit, the plants were all eaten down by cows. The weeds, however, were persistent, and later recovered entirely and told me the story of their name. It was the latter species. These instances are enough to show what may happen to disappoint the seedling hunter. Of course the cultivating of seedlings would obviate all this trouble, but I wanted the plants from their own native habitat. That gave additional zest and exercise.

One plant kept me guessing for some time. Near the banks of Charles river by a salt marsh there was a large patch of the most beautiful green. I found it to be composed of myriads of seedlings not more than half an inch in height. What were they? The small linear cotyledons told me no story. I felt all the enthusiasm of a beginner analyzing a new flower. As the little plants grew, I narrowed my guesses, till a premature blossom on a specimen not much over an inch high, told me it was *Buda marina* Dumort., the salt sand-spurrey, common enough to us all in its full dress. I shall always know it hereafter in its baby clothes. Its cotyledons much resemble, in miniature, the later leaves.

The limits of this paper will not allow a discussion of all or nearly all my seedlings, for during these delightful three months I collected between fifty and sixty species. Mention of a few may, however, be of interest. In Falmouth, Mass., early in July I found at the head of the beach in the clear sand, seedlings of some interesting species of coast plants. I was particularly attracted to *Lathyrus maritimus* Bigelow, the beach

pea, an account of whose long rootstocks I wrote in the first paper of this series. The old plants were a foot high and in flower, while scattered about among them were small plants an inch or so above the sand. I found that these were of two kinds, readily distinguishable after a short examination, namely, seedlings and young shoots from old rootstocks. I made collections of both. In almost every case the pea was attached to the seedling and it was always from two to four inches below the surface of the sand. How does the pea invariably reach that depth where the necessary moisture is always present? The constant fall winds which blow over the evershifting sands partially account for that. And yet, in the case of the little seedlings of *Euphorbia polygonifolia* L., the spurge, and *Atriplex arenarium* Nutt., the orach, as well as *Solidago sempervirens* L., the seaside goldenrod, and others which I collected in quantity, the size and position of the plants show that their seeds lay much nearer the surface of the sand, though subjected to the same conditions as those of the beach pea. In seedlings of *Xanthium Canadense* Mill., var. *echinatum* Gray, the cockle burr, the burr enclosing the akenes is buried to the same depth as that of the beach pea. This question of the distance below the surface attained by different seeds is worthy of examination. The roots of the pea seedlings, of which I examined a large number, were delicate and very white, and penetrated the moist sand for four inches below the pea. In one instance I dug up a whole pod still containing a single pea which had sprouted and sent its seedling above the sand. The pod was soft and moist, and would soon have decayed.

In Whitefield, N. H., in the rich northern woods, I made some valuable additions to my collection. It was much harder to find the seedlings in the luxuriant growth that carpets the floor of those grand forests of birch, ash, spruce, pine and maple. In the deep shade half hidden amongst the low growth that covered the ground, were seedlings innumerable even in the latter half of July. I found in abundance all forms of three of the northern maples, *Acer Pennsylvanicum* L., the striped maple, or moose-wood, *A. spicatum* Lam., the mountain maple, and *A. rubrum* L., the red or swamp maple.

In *Acer Pennsylvanicum* L., the cotyledons are from one-half to three-fourths of an inch long and narrowly obovate in shape. The first pair of leaves are ovate, heart-shaped,

taper-pointed and doubly toothed, but with no suggestion of the three lobes so characteristic of the typically developed leaf. This primitive form occurs at times even in the sixth pair of leaves, while again in the second pair the lobing becomes manifest. I have one specimen in which the third pair of leaves are very typical, while the fourth pair on the same plant have lost their lobes. This is significant when we compare the seedlings with the old plant, for in the latter case the shape of the leaves varies very much, the same tree producing every form from the typical leaf to one resembling in every detail but size the first pair of leaves above the cotyledons.

In *Acer spicatum* Lam. the seedlings very nearly resemble those of the former closely related species, and there is the same gradation to the typical leaf. The coarse serration of the developed leaf is shown in the first leaves. The downy character of the under surface of the leaf does not, however, appear till the plant is pretty well developed. The leaves on the ends of new shoots in the old plants resemble in shape and size the first leaves of the seedlings. In *Acer rubrum* L. the cotyledons are broadly linear and the first leaves have clearly the whitish under surface peculiar to the type. In shape they behave much like the two former species.

One day I was hunting in the woods on my hands and knees for new plants, when I saw a seedling with oblong thick cotyledons some two inches long. The first pair of leaves had developed. They were simple, oval, acute, serrate, and I thought that I had found at last a young birch. Judge my surprise when, on carefully removing the plant from the black mould in which it was growing, I found still attached to the base the key of the black ash, *Fraxinus sambucifolia* Lam. My seedlings of this species as well as those of the white ash, *Fraxinus Americana* L., resemble almost exactly those figured in Sir John Lubbock's work on Seedlings. The leaves above the first pair soon begin to show signs of their compound character and are of very varied shapes. I have one small plant of several years' growth. It is nine inches high and bears but one pair of leaves, both simple. One is four and one-half inches long, the other three-eighths of an inch.

The woods in Whitefield were full of the yellow birch, *Betula lutea* Mx. f., and the little seedlings were very abundant. The cotyledons are orbicular in outline with short petioles, and

the first leaves are ovate and coarsely toothed. I have a complete series of twenty-six specimens from the young seedling with fruit attached, through the varying forms to the leaves and bark of the old tree. Leaves of plants a foot high are much narrower than those of the developed form. On an old prostrate moss-grown log, I collected all forms of this birch, growing in a row as if awaiting the collector.

It was pretty delicate work mounting my seedlings. The choice lay between gum strips, gluing, and paper pockets. I decided to use the last two methods. I glued the plants in the usual way, picking them up one by one with nippers. The process was slow, but the results most excellent. Thirty specimens sometimes are on a single sheet. They are arranged in various symmetrical lines and graded according to age. Paper pockets contain extra specimens in many instances.

This short sketch of a few of my seedlings is perhaps enough to show that they should be well represented in our herbaria. Their germination has been studied by specialists in many cases, and why should we not be able to display them when we show the flowering and fruiting forms of the adult plant? And there are many other forms of our common species, besides the seedling and the old plant that should also be collected and made ready for study. There are those intermediate stages well illustrated in the early leaves of the water parsnip, *Sium cicutaefolium* Gmelin. These leaves show every gradation from the typical pinnate forms with serrate leaflets to the submersed leaves with the finest hair-like dissections. It is always the lowest leaves that show the greatest variation from the type. Sometimes these are very large, even from fifteen inches long to five inches broad. It is not always the submersed leaves that show this dissection, for I have collected specimens in Cambridge, growing entirely out of water, where the lower leaves are about intermediate between the two extremes. They are erect, while the submersed forms are extremely weak. Does not this show some connection between this species and the polymorphous *Sium Carsonii* Durand? These and many such questions must be answered by the specialist, and surely the interests of science will be furthered if our herbaria are well stocked with all these connecting forms from seed to seed.

Cambridge, Mass.

Note on calcareous algæ from Michigan.[1]

D. P. PENHALLOW.

In the latter part of the summer of 1891, Sir Wm. Dawson received from Mr. B. W. Thomas, of Chicago, some very curious and interesting calcareous pebbles formed by algæ. They were transferred to me with the request that I should report upon the nature of the organisms giving rise to them. These pebbles were found in considerable numbers in certain Michigan ponds by Dr. J. W. Velei, secretary of the Chicago Academy of Natural Sciences. The specimens were found on a smooth, sandy bottom, under about four feet of water, and the collector states that when fresh "they had so soft and slippery a feeling" that he thought they were alive. Those which reached me were said to be representative of the average size. They were found to be irregularly ellipsoidal with a thickness of about 40^{mm} and a diameter of about 60×80^{mm}. Light ashy gray, the surface was found chiefly smooth, but here and there with depressions of various sizes, frequently merging into actual cavities. The pebbles are not solid, but appear as a thickish shell-like mass surrounding an irregular cavity, such as might be conceived to arise from a progressive internal decay, concurrently with an extension of the mass from without.

Upon treating a portion of a pebble with acid to remove the incrustation of lime, it became evident that we had to deal not with an individual organism, but with a community possesessing considerable diversity of plant forms, while it was also evident that the growth of the mass had involved the inclusion of a variety of foreign bodies, some of which at least, might have served as a base for the algal growth.

From my notes taken at the time, it appears that owing to the imperfect condition of some of the plants, it was not possible to determine them conclusively in all cases. There were found, however, numerous diatoms, fragments of *Œdogonium*, *Gleocystis*, *Calothrix* and *Urococcus*, and in much larger quantity, plants of *Sirosiphon informe* Kg. Pine pollen and fragments of coniferous wood were also noted as com-

[1] I desire to acknowledge valuable suggestions by Dr. Farlow in the preparation of this note.

mon inclusions. The body of the specimen was found to consist of a plant which could not be satisfactorily determined. The material was therefore referred to Dr. Farlow, who not only confirmed the observations previously made, but ascertained that the dominant species was *Dicothrix gypsophila* (Ag.) B. & Flk. From the facts thus noted the inference was drawn that the pebbles might be regarded as veritable museums which would probably disclose some new form each time a fresh examination was made.

More recently some of these pebbles were sent to Mr. E. Grove, of England, who in turn transferred them to Mr. George Murray, of the British Museum. Mr. Grove undertook the determination of the diatoms, and has added considerably to our knowledge of the composition of these curious communal growths, by the publication of a list embracing 24 genera and 100 species and varieties.[2] This somewhat extensive diatomaceous flora is, nevertheless, hardly to be regarded as playing any special rôle in the formation of the pebbles beyond the fact of simple association, a relation which is readily understood when we recall the very universal distribution of these minute organisms, and the readiness with which they take up their abode in almost any situation.

The larger forms of plants found in the pebble were determined by Mr. Murray, who has given, in addition to other figures, excellent drawings showing the general external characteristics of the pebbles. His determination of the components showed that, "the predominating kind was clearly a species of *Schizothrix* while mixed with it there were other forms, notably filaments of *Stigonema* and *Dicothrix*."

Not arriving at a satisfactory conclusion respecting the first, Mr. Murray referred the matter to M. Gomont as final authority, who reported that, "the interior of the calcareous mass is formed of entangled filaments; they appear to belong to a *Schizothrix*, but which?" Finally he says, "I do not think one can make anything very distinctly out of this specimen except *Schizothrix fasciculata*, which undoubtedly occurs in abundance."[3] Excellent figures of this plant are given by Mr. Murray.

It would thus appear that from two independent sources we have results which, while agreeing in many respects, fail

[2] E. Grove.—Diatomaceous remains observed in preparations and washings of calcareous algæ. London. 1895.

[3] George Murray.—Calcareous pebbles formed by algæ. London. 1895.

to agree as to the character of the dominant plant, and the idea derived from the observations of Dr. Farlow and myself, that there is no element of constancy in the composition of the flora of these pebbles, beyond the fact that two or three species are in excess, would thus seem to be greatly strengthened.

Apart from the species found in the pebbles, but which could hardly have played any part in their original formation, it will be seen that there are present two and perhaps three species which, by their concurrent growth, may have produced them. It would be of great interest to know whether these large concretions are due to the growth of a single species, or, if to the combined growth of several species, the relative part which each plays. It is, therefore, to be hoped that some observer will watch the locality and obtain quite young material which alone will afford the means of settling this interesting question.

McGill University, Montreal.

Notes on Isoetes riparia and Isoetes saccharata.

T. CHALKLEY PALMER.

DISTRIBUTION.—In the middle states both these species are accounted quite local. Farther north *I. riparia* Engelm. is recorded as coming from several places, but south of New England it is apparently confined to the tidal shores of the Delaware river.[1] So far as known, *I. saccharata* Engelm. is still more restricted in its range; and, in fact, it had been, until quite lately, collected only by Wm. M. Canby, its discoverer, within quite circumscribed areas on the two neighboring Chesapeake rivers, Wicomico and Nanticoke, where it was first seen in 1863.

The writer has had the good fortune to find, during the last three years, in a number of coves and creeks about eighty miles farther north, a series of forms which, though departing in cases a good deal from the type, seem referable to *I. saccharata* Engelm., and to it only. These new stations are in Sassafras and Elk rivers, which are in effect broad, short arms of Chesapeake bay near its head, piercing the hilly "eastern shore" of Maryland.

The Back creek station, in Elk river, is within two miles of the Delaware and Chesapeake canal at its western end; and within perhaps seven miles of the eastern end of the same canal, on the Delaware river, grows *I. riparia.* Near relatives these two species have long been known to be. Now they are found to be near neighbors as well.

TYPE CHARACTERS.—Dr. Engelmann's descriptions have fixed these, and in order that the ensuing notes may not lack in clearness, they are here reproduced in full.[2]

I. saccharata Engelm.—A small plant, usually with a flat, depressed trunk; leaves subulate, olive green, spreading, ten to twenty in number, two to three inches long; sporangium spotted, oblong, with narrow velum; ligula triangular; macrospores 0.40 to 0.47^{mm} thick, covered with very minute distinct or sometimes a little confluent warts; microspores papillose, 0.024 to 0.028^{mm} long.

[1] Engelmann: Trans. St. Louis Acad. Sci. **4**: 382.
[2] Engelmann: loc. cit.

I. riparia Engelm.—A larger plant with slender but rather rigid deep green leaves (about fifteen to thirty in number) four to eight inches long, rarely longer; stomata numerous, dissepiments thick, consisting of about four layers of cells; sporangium mostly oblong, distinctly spotted by groups of brown sclerenchym cells, one-fourth or rarely one-third of it covered by the velum; macrospores among the largest, 0.45 to 0.65^{mm} in diam., marked with jagged crests isolated or anastomosing especially on the lower surface, which thus becomes somewhat reticulated; microspores more or less tuberculated, 0.028 to 0.032^{mm} long.

It is to be remarked that few hard and fast contrasts are established in the above descriptions. A difference of color, a larger size, a larger number of leaves are not such items as will help greatly to determine the allegiance of any doubtful plant in hand. Spore characters alone seem definite. (The relative *sizes* of the microspores are made a good deal of by Dr. Engelmann.) The sporangia of both are spotted, though a kind of distinction is for some reason attempted in Gray's Manual, 6th edition, where the sporangium of *I. saccharata* is stated to be "nearly unspotted."

Biologically, so far as known and studied, the two species have been thought quite similar.

VARIATIONS.—*I. riparia.* My acquaintance with this species, as it occurs on the Delaware near Chester, Pa., and immediately opposite on the New Jersey shore, extends over several years. It confines itself to clay-gravel tidal banks which are capped either with mud or fibrous growths that prevent the spores being washed away by the storm-tides. A large number of plants gathered in August, 1894, showed a majority with all mature leaves decidedly longer than the limit given. The usual, not the occasional, length was nine and three-fourths to ten inches. The color was dark green. The bulb or crown, when carefully measured, was found to be one-half to five-eighths of an inch in diameter. The sporangia were oblong, 4 to 5^{mm} long. The velum covered two-thirds to three-fourths of the sporangium, instead of but one-third. The macrospores were of the usual size, 0.50 to 0.63^{mm}, with the ridges quite jagged, and more or less reticulated. While gathering these plants I noticed many, only to reject them, which seemed to have lost their outer leaves, for they bore no macrosporangia. Only those plants were collected,

the bulbs of which were obviously swollen with mature macrospores. The gathering was not studied closely until winter. So it comes that I cannot here give measurements of microspores; but in place of doing so, I have to announce that *I. riparia* is polygamous.

All the plants collected in August were found to bear mature macrospores all the way to the center. The whole gathering, minus a quantity pressed and sent away for exchanges, consisted of about twenty-five plants. It afforded not a single microsporangium. Only two or three immature leaves in the center of each plant were without spores of any kind. The number of leaves was as large as usual, and in some cases larger.

In August and September of 1895, in the same place, many plants were found with only two or three macrosporangia, others without any, and others with macrosporangia only. Six duplicates, remaining from a collection in 1890 (September) much smaller than the above, but still *I. riparia*, yielded but a single microsporangium, while macrospores, mature and immature, extended all the way to the center. Two plants collected at Pennsgrove, N. J., August 23, 1895, were likewise entirely female, though quite mature. These were of another outer aspect, but the spores showed them to be *I. riparia.* The leaves were of a dull green, five inches long, widely spreading. The crown measured five-eighths of an inch, the sporangium about 7^{mm}. Macrospores were 0.51 to 0.58^{mm} thick, irregular and distorted in shape, and covered with such a mass of crowded and crested ridges as to hide completely the surface proper. The rims of suture and the rim between the hemispheres were also jagged and quite remarkably high. The velum was broad, covering three-fourths of the sporangium. These plants approached some forms of *I. saccharata* in aspect.

Some smaller plants, collected in August, 1895, near Chester, rather darker green in color, were monoecious. The leaves are but four to four and one-half inches long, somewhat spreading; sporangium ovoid; velum quite narrow to one-third the sporangium; macrospores 0.38 to 0.47^{mm} and marked much as in some forms of *I. saccharata.* In fact, these spores, and those from some Chesapeake plants, do not admit of distinguishing descriptions.

The microspores of *I. riparia* vary, by actual measure-

ment, from 0.026 to 0.030^{mm}. The "tubercles" with which they are beset are more plentiful, and so more obvious than the papillæ of the other species, but scarcely differ from them in appearance.

I. saccharata. The structural variation here is apparently greater than in the other species, while any dioecious tendency is still to be detected. Plants were collected at the original station on Wicomico river, Sept. 14, 1895, where they grow plentifully in sand deeply overlaid with mud. These agree, for the most part, with the description of Engelmann. But the leaves of mature plants are generally three to five inches long, and the macrospores 0.48 to 0.55^{mm} thick, with warts a good deal confluent, especially below, but not reticulated. The microspores measure 0.024 to 0.028^{mm} long. The olive green color, the rather flaccid state of the leaves, and the constant narrow velum were sufficiently noticeable. The whole plant, though taller than one would expect, is of quite slight build. The trunk is very small.

In 1895 I noted[3] the collection of this species in Elk river, at Piney creek cove and Back creek. In August of the same year it was observed in other places in the same river. As it appears there, it is a more robust plant than on the Wicomico. The leaves are somewhat stiffer, of a deeper green, and of a nearly uniform length of three to three and one-half inches. Though less flaccid, they are generally strongly curved, and their ends mostly rest upon the ground. The crown measures one-half to three-fourths inch in diameter; the macrospores are 0.40 to 0.48^{mm} thick, with warts but little confluent above, blunt and not at all crested. The microspores are 0.028 to 0.030^{mm} long, quite as long as those of *I. riparia*, but less plentifully knobbed than the latter. The velum varies but little, never reaching more than one-fourth the sporangium. The sporangium is sometimes 5^{mm} long, while that of the Wicomico plants is at most 3.5^{mm}. The trunk is not different from the typical trunk of the species.

On August 12, 1895, two more forms of the species, which further study may show to be worthy of distinction as varieties, were collected in Lloyd's creek, Sassafras river. The first of these, the most robust form of the species yet observed, has almost precisely the general aspect of the *I. riparia* collected at Pennsgrove, N. J., and described above. It

[3] Botanical Gazette, **20**: 32. Ja. 1895.

has stiffish, strongly curved leaves, rather dark green in color, 4 to 6 inches long. The crown measures one-half to one inch in diameter. The macrospores are 0.51 to 0.55^{mm} thick, marked with somewhat crested warts, higher and more confluent into twisted ridges than in the Wicomico plants. The microspores are 0.026 to 0.028^{mm} long. The velum is narrow. The sporangium is 6 to 7^{mm} in length, very long and slim. The microsporangium has much the same shape as in *I. Engelmanni* var. *valida*. This form was plentifully planted in rather coarse gravel, overlaid with a shallow mud.

Close beside, in densely compacted masses, grew the second form. The leaves are about the same darkish green, 8 to 9 inches long, and remarkable for the number and size of their stomata. These leaves spread less widely than in the form next preceding. The crown is about one-half inch in diameter. The macrospores are 0.51 to 0.53^{mm} thick, with warts quite crowded and confluent into twisted ridges below, sometimes a little reticulated; above, the ridges are somewhat parallel; and in general the markings may be said to differ markedly, in both these Lloyd's creek forms, from the type. Microspores are 0.024 to 0.032^{mm} long. The sporangia are about 7^{mm} long when longest. The velum is narrow.

In color, size of sporangium, and general outward aspect the two Lloyd's creek forms vary in a notable manner from the *Isoetes saccharata* type of Engelmann. This variation is in the direction of *I. riparia* as it presents itself in the plants collected at Pennsgrove, N. J. and above described. The macrospores are of an approximately equal size. But here the resemblance ends; for the macrospores of the Pennsgrove plants are, as stated, quite peculiarly deeply ridged, even for *I. riparia*; the velum is unusually broad; the habit is dioecious.

On the other hand, the small forms of *I. riparia* noted above, from Chester, Pa., vary in spore characters toward the Lloyd's creek plants, to such an extent that if such characters alone could settle the question, the two would have to be classed together. Yet here, as is the former case, the velum is often broader than in any known form of *I. saccharata*.

My study of these two species is as yet incomplete, and final conclusions as to their relations are scarcely permissible. The foregoing notes must make it evident that distinctive structural characters are less numerous even than would ap-

pear from Engelmann's account. Yet there appears to be an unmistakable specific distinction. The widely varying velum of *I. riparia* (from quite narrow to three-fourths the sporangium), and its spores differing so remarkably in size and markings, as well as the varying habit of growth and gradations of color; and the wide departures from the type in point of size, color and spore characters in *I. saccharata* may well cause doubt at times as to individual plants. But the narrow velum of the latter seems to be a constant feature, while in *I. riparia* it varies from leaf to leaf of the same plant. This single definite character, constant in the most aberrant forms, seems to me to gather significance as other characters vary, until it becomes as it were a touchstone. Moreover, until dioecious tendencies are made out in *I. saccharata* there is good reason for specific distinction.

Media, Pa.

On some species of the genus Meliola.

F. S. EARLE.

Meliola tenuis B. & C.

A fungus was distributed under the above name by Ravenel[1] on leaves of Arundinaria from Darien, Ga., but no description was given. It is mentioned by Cooke,[2] who merely remarks: "Scarcely different from *Meliola amphitricha.*" It is mentioned by Saccardo[3] under the heading "*Species mihi minus notæ*", where he simply quotes Cooke's remark as given above. It is next mentioned by Martin[4] as Ravenel's no. 330. He gives no description, but says: "This appears to be *M. amphitricha* Fr.

In the *Supplementum Universale* Saccardo[5] publishes a description for the first time. It is as follows: "*Meliola tenuis* B. & C., Ravenel, Fungi Amer. Exsic. *no. 831* (without description).—Epiphyllous, forming small, black, hairy, suborbicular spots; perithecia globose, covered with rigid, straight, sharp-pointed setæ; asci 2–4-spored, ellipsoid; sporidia oblong, 50×18–20μ, 4-septate, slightly constricted, extremities rounded, fuliginous; pycnidia present, smaller than the perithecia; stylospores oblong, 1-septate, multiguttulate, hyaline, 25–26×6–7μ." This description would certainly justify the remarks of Cooke and Martin, that it was near to or identical with *M. amphitricha* Fr.

Gaillard[6] in his admirable monograph places *M. tenuis* B. & C. among "*species dubiæ.*" After quoting Saccardo's description he makes the following remarks: "We have examined authentic specimens from Ravenel's no. 831. They offer the following characters: Spots pulverulent, of a deep black brown color. Mycelium formed of moniliform cells of a pale fuliginous brown, bearing occasionally little spherical swellings, from which globular, thin-walled, sterile conceptacles

[1] Ravenel, Fungi Americani Exsiccati *no. 331.*
[2] Cooke, Ravenel's American Fungi, Grevillea—: 49. D.1878.
[3] Saccardo, Sylloge Fungorum **1**: 70. Je.1882.
[4] Martin, Synopsis of the North American species of Asterina, Dimerosporium and Meliola, Jour. of Mycology **1**: 148. D.1885.
[5] Saccardo, Sylloge Fungorum **9**: 428. S.1891.
[6] Gaillard, Le Genre Meliola; Anatomie, Morphologie, Systematique 117. 1892.

develop. Mycelial setæ very abundant, acicular, thin (200 ×6μ), of a clear fuliginous brown, with numerous septa. The moniliform mycelium, the absence of hyphopodia and of spores cause us to place this plant among the doubtful species."

Ravenel's specimens seem to be the only ones known of this fungus. Some confusion exists in quoting his numbers, they being variously given as 330, 331 and 831. These seem to be simply misprints of the same number. The specimen in the herbarium of the Division of Vegetable Physiology and Pathology of the U. S. Department of Agriculture is certainly Fungi Amer. Exsic. *no. 331.*

In the fall of 1893 I was fortunate enough to collect this little-known species on *Arundinaria tecta* at Ocean Springs, Miss. The characters found in these specimens differed so markedly from any described species that I was inclined to think it new, since they afforded the combination of such distinctive marks as the divided tips of the setæ and the conspicuously lobed apical cell of the capitate hyphopodia. I find, however, that it agrees exactly with Ravenel's specimen Fungi Amer. Exsic. no. 331, as represented in the herbarium here.

Saccardo's description is incorrect as to the setæ and he does not mention the hyphopodia at all. The specimens examined by Gaillardwere evidently very imperfect or immature.

The following description is taken from Ravenel's specimen no. 331 in the herbarium of the Division of Vegetable Physiology and Pathology, and from the Mississippi specimens. It is believed to give the true characters of the species:

MELIOLA TENUIS B. & C., nov. desc.—Amphigenous, covering small (2–3^{mm}) black orbicular or at length confluent areas: conidia-bearing mycelium light fuliginous, somewhat flexuous, branched, frequently septate, not constricted at the septa, 6–7μ thick; conidia not observed: perithecia-bearing mycelium abundant, dark fuscous, irregularly flexuous and nodular, frequently septate, 8–9μ thick: capitate hyphopodia abundant, alternate, about 20–25μ long; basal cell short-cylindrical about 8 × 8μ; apical cell broader, usually irregularly but distinctly three or four lobed, 12–15 × 12–20μ; setæ abundant, rigid, dark and opaque, 200–400 × 10μ, acute, the tip often bifid, trifid, or occasionally 4-parted for a distance of 10–20μ: asci ovate, thin-walled, often evanescent, 2–4-spored, 50–70 × 35–40μ: sporidia dark fuscous, 4-septate,

constricted at the septa, ends obtusely rounded, 50–60μ long, somewhat flattened, seemingly elliptical, 18–20μ wide in front view, but cylindrical and 12–15μ wide in side view.—On living leaves of Arundinaria, Georgia and Mississippi.

Notes on specimens of Meliola.

Perhaps no group of fungi is in greater confusion in most American herbaria than the species of Meliola and their allies in the other genera of the Perisporiaceæ. This is largely attributable to the fact that the specimens of so many published exsiccati are incorrectly named. Having recently had occasion to examine the specimens in the herbarium of the Division of Vegetable Physiology and Pathology of the U. S. Department of Agriculture, the following notes may prove of general interest:

Meliola amphitricha Fr., Bonin Islands, U. S. North Pacific Exploring Expedition.—This is mentioned by Gaillard[7] among the forms which he refers to *M. amphitricha* Fr., but this specimen differs from his description in the much smaller (only 16 × 12μ) capitate hyphopodia, which often have the apical cell conspicuously lobed, and in the evident false ostiolum of the perithecium. The sporidia also differ in being strictly cylindrical (not elliptical), with the rounded apical cells longer than the rather short medial ones.

Meliola amphitricha Fr., on *Callicarpa americana*, Gainesville, Florida, Ravenel: Fungi Amer. Exsic. *no. 84.*—This is *Meliola cookeana* Speg. It is the same as N. A. F. *no. 1295.*

Meliola amphitricha Fr., on *Gordonia lasianthus*, Louisiana, 1885, coll. Dr. Palmer (herb. no. 1785).—This is *Meliola cryptocarpa* E. & M., and is the same as N. A. F. *no. 1293.*

Meliola amphitricha Fr., on *Laurus carolinensis*, Houston, Texas, 1869, coll. H. W. Ravenel, no. 116*a*.—This is not a Meliola, but is *Asterina dillitescens* E. & M.

Meliola amphitricha Fr., on *Laurus carolinensis*, Ravenel: Fungi Caro. *no. 70.*—This is *Meliola martiniana* Gaillard.[8]

Meliola amphitricha Fr., on *Persea palustris*, Green Cove Springs, Florida, March, 1883, Dr. Martin, N. A. F. *no. 1296.*—This is the type of *Meliola martiniana* Gaillard.[9]

[7] Gaillard, A., Le Genre Meliola 77. 1892.
[8] L. c. 68.
[9] L. c. 68.

Meliola amphitricha Fr., on Persea, Gainesville, Florida, Fungi Amer. Exsic. *no. 82.*—This is not a Meliola. Our specimen has no perithecia, but it is doubtless *Asterina dillitescens* E. & M.

Meliola amphitricha Fr. var. *palmarum* Berk., on *Phoenix dactylifera*, Calcutta, India, Thüm. Mycotheca Universalis *no. 2155.*—This is referred by Gaillard[10] to *Meliola palmicola* Wint. Our specimen while it agrees with the usual form of this species on Sabal in the long, often three-celled hyphopodia, does not show the divided tips of the setæ.

Meliola amphitricha Fr., on Sabal, Gainesville, Florida, Ravenel: Fungi Amer. Exsic. *no. 81.*—This is *Meliola palmicola* Wint.

Meliola camelliæ (Catt.) Sacc., on *Camellia japonica*, Italy, Briosi e Cavara *no. 106.*—This, like the other "sooty molds" following insect injuries, does not at all present the characters of a true Meliola, and I quite agree with Gaillard[11] in excluding them. It is likely that all these true saprophytic forms should be referred to Capnodium, even if the ordinarily accepted definition of that genus has to be extended to include them. They form a natural group and so do the true Meliolas, but they have little in common.

Meliola furcata Lév., Ellis N. A. F. *no. 1297*, (*a*) on *Bignonia capreolata*, Florida, Dr. Martin; (*b*) on Gonolobus, North Carolina, Dr. Thos. F. Wood; (*c*) on *Sabal serrulata*, Florida, Dr. Martin.—Both (*a*) and (*b*) are *Meliola bidentata* Cke. Gonolobus is a new host for this species, but the specimen agrees exactly with the description given by Gaillard[12] and with the specimens on Bignonia; (*c*) is *Meliola Palmicola* Wint.

Meliola furcata Lév., on Bignonia, Gainesville, Florida, Ravenel: Fungi Amer. Exsic. *no. 330.*—This also is *Meliola bidentata* Cke., and is perfectly distinct from *M. furcata* Lév. which is represented in the herbarium by the N. Pacific Exploring Expedition specimen collected by Wright in Nicaragua, but which has not been found in the United States.

Meliola heteromeles (C. & H.), N. A. F. *no. 1546.*—Our specimen seems to be all Capnodium. I find nothing to indicate either Meliola, Meliopsis or Zucalia, where it has been variously placed.

[10] L. c. 101.
[11] L. c. 123.
[12] L. c. 106.

Meliola MacOwaniana Thüm., Mycotheca Universalis *no. 568.* — This is *Dimerosporium Mac Owanianum* (Thüm.) Sacc.[13] The sporidia are only two-celled.

Meliola penzigi Sacc., Briosi e Cavara *no. 135.*—This too is Capnodium, not Meliola.[14]

Meliola psilostomæ Thüm., Mycotheca Universalis *no. 775.* —This is *Dimerosporium psilostomatis* (Thüm.,) Sacc.[15]

Meliola quinquespora Thüm., Mycotheca Universalis *no. 657.*—This is referred by Gaillard[16] to *Meliola inermis* Kal. & Cke.

Meliola sanguinea E. & E., on *Rubus trivialis*, Pointe à la Hache, Louisiana, Jan. 5, 1886, A. B. Langlois.—This is considered by Gaillard[17] to be the same as *Meliola manca* E. & M., which also occurs on Myrica (see N. A. F. *no. 1292.*

Meliola (young), on Ilex, Harris co., Texas, H. W. Ravenel.— This is not Meliola, but *Asterina pelliculosa* Berk. Another specimen on Ilex from Galveston, Texas, collected by Ravenel in 1869, has two leaves like the above showing nothing but *Asterina pelliculosa* Berk., while a third leaf bears a good Meliola, perhaps *M. amphitricha* Fr.

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Washington, D. C.

[13] Saccardo, Sylloge Fungorum **1**: 53.
[14] Gaillard, l. c. 123.
[15] Saccardo, Sylloge Fungorum **1**: 54.
[16] Gaillard, l. c. 123.
[17] Gaillard, l. c. 37.

Noteworthy anatomical and physiological researches.

The embryo-sac of Taraxacum.

Now that morphological attention among angiosperms, especially the dicotyledons, is being focussed upon the embryo-sac, it is important to note any careful observations that have been made. In *Flora* **82**: 32 *et seq.* 1896, Siegfried Schwere has published an elaborate paper upon *Taraxacum officinale*. Its scope includes the topics: (1) the present condition of the embryological question; (2) the embryo-sac, fertilization and formation of the embryo; (3) formation and resorption of the endosperm; (4) the integuments and later seed coats; (5) the pericarp; (6) biological considerations. Only the main points of the second topic are here considered. The author discovers that Taraxacum often has two ovules in the ovary, which may differ in size, but otherwise show normal development. No fruit was found containing two mature seeds, but two embryo-sacs were seen, each containing an embryo developed sufficiently to show the cotyledons. The egg-cell, which is rather deep in the sac, is easily recognized by its size and contour, and its nucleus is nearly as large as the endosperm nucleus. The synergidæ are at the extreme end of the sac and do not extend into it nearly so far as the egg-cell, and their nuclei are smaller than those of the egg-cell and the endosperm-cell. The synergidæ persist for an unusually long time, retaining a plump appearance after walls have begun to form in the endosperm. The antipodals vary in size, shape and arrangement, but their number, three, is constant. The author seems to doubt Hegelmaier's statement that in Taraxacum he had observed four or five antipodals in a longitudinal row, but recent studies in Compositæ suggest that such a condition is not at all unlikely. The antipodals are said to persist as long as the synergidæ. The author claims to have discovered in Taraxacum the first case of synergid fertilization noted in dicotyledons. Whether such a sac would develop two embryos or not is a question yet to be determined.

The first division of the fertilized egg-cell separates an embryo-cell from a suspensor-cell, and the latter retains its charac-

ter during the first divisions of the embryo, after which it begins to divide in basipetal order. When the embryo begins to show cotyledons, the suspensor, with the exception of the so-called "hypophysis," contains a row of from two to four cells. When the growing cotyledons have given the embryo the characteristic cordate form, the number of suspensor-cells is also found to have been increased. The "Anschlusszelle," or suspensor cell next the embryo, plays a special rôle. The other suspensor cells divide in somewhat irregular fashion, but in this one the first wall is vertical, and vertical divisions follow in planes at right angles to each other. This does not agree with Fleischer's account of Helianthus, in which the Anschlusszelle has two transverse walls before vertical divisions begin. A little later, vertical divisions occur in the cell below the Anschlusszelle. The descendants of these two cells take part in the formation of the embryo, which by this addition has become nearly spherical.—CHAS. CHAMBERLAIN.

Correlation effects following mechanical hindrance of growth.

In a recent contribution on growth-correlations, Dr. Franz Hering[1] reports some very interesting results. He takes issue with the conclusion reached by Kny[2] that the growth of root and shoot of seedlings proceeds with a high degree of independence, and points out that in his study Kny took cognizance only of the end-results of growth through long periods and neglected to look for temporary modifications that were soon concealed by further growth. Hering finds that interdependence between these systems is pronounced. He cites experiments by Stone showing that when the epicotyl was removed from a seedling, the growth rate of the root immediately decreased; after a time, however, it regained and, indeed, surpassed its normal rate, as a result of the increased activity connected with the process of repair. In consequence, the total growth during an extended period would equal or exceed that of the control objects.

By use of Pfeffer's method of confining parts in plaster of Paris casts, the author investigated the action resulting from mechanical hindrance of the growth of a system, or of a part

[1] Ueber Wachsthumscorrelationen in Folge mechanischer Hemmung des Wachsens. Pringsh. Jahrb. f. wiss. Botanik **29**: 132–170. 1896.

[2] Annals of Botany **8**: 265. 1894.

of a system on adjacent and on remote parts of the plant. When either the root or the shoot system was incased, a plain retardation of the growth of the free system was always seen. This retardation differed somewhat from that observed when the part was simply amputated. Instead of a recovery following the shock from the injury, the author found that the continued irritation from the confined parts caused a likewise continued retardation with a total growth (in the case of the radicle) averaging about two-thirds of that of the control. Upon freeing the confined parts, a plainly marked acceleration of the growth rate of both systems followed.

The cotyledons of Streptocarpus behaved in a very interesting manner. Normally one cotyledon grows until it reaches considerable dimensions. The other, however, remains rudimentary, and finally dies. When the cotyledon in the usual order of things predestined to development was put in the cast, the smaller usually fugacious member assumed the rôle and grew, provided the development of the seedling had not already proceeded too far. A similar result was obtained by the extirpation of the larger cotyledon. Thus the prevention of growth in one part can awaken it in another.

The question of correlation within a particular system was investigated. If the cast was so placed as to leave free the apex and entire growing zone of a radicle, a retarded growth resulted. Neither the revival of growth in old tissues, nor a changed distribution of growth was found to follow the application of the cast preventing normal elongation. When only partially hindered, growth was reduced but not re-localized.

When shoots of various kinds of seedlings were correspondingly treated, the correlation phenomena agreed completely with those seen in roots. Shoots so enclosed that growth in length merely was prevented, grew abnormally in thickness, but on the release from the cast it was resumed in the parts still plastic.

From these results, it appears that, without sufficient development in the sustaining parts, the sustained meristematic regions are unable to make a strong development.—R. H. TRUE.

Fertilization of Batrachospermum.

In the *Annals of Botany* (March) Dr. Bradley M. Davis has recorded some important results from his study of the fertilization of Batrachospermum. The species chiefly studied was *B. moniliforme*, subsequently checked by a study of two

other species, *B. coerulescens* and *B. Boryanum.* The results have to do not merely with the genus studied but with the whole subject of fertilization. The trichogyne of Batrachospermum is found to be a cell entirely distinct from the so-called carpogonium, as witnessed by its well-organized nucleus and its chromatophore. The antherozoids also contain a chromatophore derived from the vegetative cells, and a distinct nucleus. In the act of fertilization the antherozoid and trichogyne walls fuse, a larger or smaller opening is developed, and cytoplasmic fusion occurs, but the antherozoid and trichogyne nuclei remain distinct, apparently indifferent to the process, the antherozoid nucleus for the most part not even entering the trichogyne. As soon as cytoplasmic fusion occurs the trichogyne becomes separated from the carpogonium by the gradual drawing apart of the cell-contents until the connecting strand becomes so thin that it breaks, and by a deposit of substance similar to cell-wall material. The carpogonium subsequently gives rise to the spore-producing filaments. The nuclei of the antherozoid and of the trichogyne were repeatedly observed in various stages of fragmentation after fertilization had been accomplished. The striking results are the distinct cell-nature of the trichogyne, and the process of fertilization, consisting as it does of fusion which does not involve the nuclei. That all fertilization hitherto observed involves cytoplasmic fusion as well as nuclear is well-known; but that it should be so modified as to involve the former and not the latter is entirely unexpected. It is not necessary to conclude that nuclear fusion may not be an essential feature of well-organized fertilization, for these observations upon Batrachospermum may indicate, as Dr. Davis suggests, that the genus is losing its sexual habit, and is tending toward apogamy. Even if this be true, however, the puzzling feature still remains that the carpogonium will not produce its fertile filaments, as clearly shown by experiments, without the antherozoid contact. It is evident, therefore, that the fusion, even if the nuclei are not concerned, shows its sexual character in its effect. The author also suggests the hypothesis that sexual reproduction in these low forms may not of necessity involve nuclear fusion. We certainly know too little concerning the behavior of the nuclei in the sexual processes of the thallophytes in general, and concerning the whole trichogyne subject in particular, to venture upon much generalization concerning these very interesting and important observations upon Batrachospermum.

BRIEFER ARTICLES.

Some new or rare plants.—**Phaseolus (DREPANOSPRON) smilacifolius**, n. sp.—Stem scandent, strigose-pubescent, 5–12^{ft} high, twining over bushes with the habit of Apios: leaflets large, 5–6^{cm} long, 5^{cm} broad, thin, glabrous above and below, in outline deltoid-hastate, usually more or less 3-lobed, the basal lobes rounded, the apical one acute; stipules and stipels linear, minute, persistent: flowers in loose elongated racemes; pedicels filiform, unibracteate at base, 1–1.5^{cm} long: calyx campanulate, with five obscure very obtuse teeth: corolla pink or white, rather large, 1^{cm} long: legume nearly straight, glabrate, much compressed, 4–6-seeded, 5–6^{cm} long, 1^{cm} broad.

The section Drepanospron of Bentham, or Euphaseolus, to which this species belongs, is distinguished from the Strophostyles group chiefly by the racemose or often paniculate, instead of capitate inflorescence. The other North American members of the section are *P. retusus* Benth. and *P. Wrightii* Gray, both from the southwest: *P. sinuatus* Nutt., a Florida species, and our common northern wild bean, *P. polystachyus* (L.) B. S. P. Of these *P. Wrightii* has leaflets very deeply and very variously lobed, while the other species have rhombic-ovate nearly entire leaflets; our plant is remarkable both for the similarity of its leaves to those of *Smilax Bona-Nox*, and for their thin texture; the legume, moreover, is very nearly straight, and not falcate as in other members of the group. It was found in abundance by Mr. George V. Nash on hammock land near Lake City, Florida, August 31, 1895 (type no. 2505 in U. S. National Herbarium.)

PHACELIA COVILLEI S. Watson in Gray Man. 360. 1891. [Ed. 6.]—This interesting little Phacelia was collected originally May 5, 1889, by Mr. Frederick V. Coville on Larkspur island in the Potomac, about five miles above Washington, D. C. The plants were sent to Dr. Watson for determination, and were finally identified and described by him as a new species.

Larkspur island is the third in the series of islands above Little Falls. It is lower than most of the others, and was apparently inundated by the floods resulting from the heavy rains of the ensuing season. At all events, no trace of the plant could be discovered, either in the original locality or on any adjacent island until last April, when it was found most unexpectedly by Mr. Coville, Mr. Hicks, and others, including the writer, at several points along the river bank above Glen Echo, Maryland, very nearly opposite its original station.

In every case it grew in moist alluvial soil and was unaccompanied by either *Ellisia nyctelea* or *Phacelia parviflora*, between which *P. Covillei* has been supposed by some to be a hybrid. It is apparently the only eastern Phacelia with a campanulate corolla; and this circumstance, together with the fact that it has the aspect of Ellisia and the capsule of Phacelia, no doubt suggested the theory of possible hybridization.

PERILLA FRUTESCENS (L.) Britton, Mem. Torr. Club **5**: 277. 1894.

Ocimum frutescens L., Sp. Pl. 597. 1753.

Perilla ocimoides L., Gen. Pl. Ed. 6, Add. 578. 1764.

This Asiatic mint is reported in the last edition of Gray's Manual[1] on the authority of Schneck, as growing about dwellings and roadsides in southern Illinois. It had been collected by Professor Lester F. Ward at Crystal Spring in the District of Columbia, and is included in the "Catalogue of the Plants of the District"[2] though referred with hesitation to Bentham's variety *crispa*[3] which is a mere garden form. Additional specimens have been examined in the Herbarium of Columbia College collected at scattered points in New York, New Jersey, Pennsylvania, West Virginia, Georgia and Missouri. On October 28, 1895, Mr. L. H. Dewey and the writer came most unexpectedly on the plant growing in a large patch on the border of some woods near Waterloo Station, Alexandria Co., Va. It was then in good fruiting condition and easily identifiable.

CASSIA MULTIPINNATA NASHII Pollard, Bull. Torr. Club. **22**: 515, 1895. —Since the publication of some notes on Florida cassias, specimens have been received from Miss Josephine Skehan, collected the past summer at Ocean Springs, Mississippi, which are undoubtedly referable to the above variety, having all the characters of *C. multipinnata*, but being of low, diffuse habit. The plant may very probably occur at different points along the Gulf coast, both in the typical and the varietal form[4].

LIMNANTHEMUM NYMPHOIDES Hoffmg. & Link, Fl. Port. **1**: 344. 1809.—This plant, together with *Trapa natans*, has become so thoroughly naturalized in ponds of the U. S. Fish Commission in Washington that it covers the surface of the water and has spread into several adjacent pools. In October a beautiful sight is presented by the multitude of yellow blossoms open in the sunlight.

[1] Gray, Man. 407. 1891. [Ed 6.]
[2] Bull. U. S. Nat. Mus. **22**: 104. 1881.
[3] DC. Prodr. **12**: 164. 1848
[4] Since the above was written, Prof. S. M. Tracy, of the Mississippi Agricultural Experiment Station, has sent me a complete representation of the cassias growing in that state, from which it appears that both *C. multipinnata* in the typical form and *C. depressa* (loc. cit.) occur there.

RHAMNUS FRANGULA L., Sp. Pl. 193. 1753.—Mr. W. M. Van Sickle, of West New York, N. J., reports the discovery of additional specimens of this interesting European buckthorn in the swamp at Secaucus, some distance from the present known locality at New Durham. The problem concerning its mode of introduction into the United States is a difficult one to solve. The fact of Michaux's Arboretum having been situated on the site of the present New Durham swamp indicates that it may have been originally planted there, and thriving under favorable conditions, spread rapidly and in time developed trees of the size now found. It was long ago reported from Flushing, Long Island, but this station is now apparently obliterated.—CHARLES LOUIS POLLARD, *Washington, D. C.*

Pebble mimicry in Philippine island beans.—In looking over a keg of pebbles collected from the coast of Marinduque by Dr. Joseph B. Steere in his expedition of 1887–8, some beans were found which surprisingly resemble the water-worn pebbles with which they were associated. The mimicry is so perfect that almost every one is deceived until an opportunity for handling them is afforded, and even after being made aware of their nature mistakes will still occur. Inquiry developed the fact that these beans are produced by a coarse briar confined, as was expected, to the narrow strip of gravelly beach and met with here and there upon various members of this group of islands. Sending out trailing stems to a distance of twenty to thirty feet, carrying a leaf similar to that of the rose, they form a mat from three to four feet in height quite difficult to penetrate. Dr. Steere found the natives collecting them for shipment to Manila, to be used, as they said, in the manufacture of soap.

The beans, themselves, are sub-ellipsoidal in form, but show much irregularity in shape, apparently from mutual pressure in the pod. Indeed, here is one of the striking points of the mimicry, some perfectly resembling well rounded beach pebbles, while others mimic pebbles which have been broken across and then had their sharp edges rounded by continued friction. A handful of the beans shows as much and the same character of variation as is seen in the same number of quartz pebbles. The size is as variable as the shape, the three dimensions ranging in different specimens studied from 10 to 23^{mm}; in a typical specimen being about $17 \times 18 \times 14^{mm}$. The color varies from moderately dark to light drab, some giving a faint greenish tinge, while the luster of many is exactly that of chert pebbles. In others of lighter color the effect is similar to that obtained from pebbles of chalcedony or of crystallized quartz. Nearly all the specimens show a series of approximately parallel darker

lines passing around, very suggestive of stratification. All are quite hard, cut only with difficulty with a knife, and when shaken together in the hand give that clinking sound, only somewhat duller, which is characteristic of pebbles. The mimicry then is that of mixed quartz pebbles and covers *shape*, *size*, *color*, *luster*, *hardness* and *stratification*. It is so complete and perfect that it can not be regarded as mere coincidence. Placed in water the beans are found to be buoyant and nine weeks soaking in sea water, at about 70° F. seems to make no impression upon them, proving that they might be transported to considerable distance by waves and ocean currents.

It becomes a matter of interest to offer some speculation as to how this mimicry may have been produced since the principles involved seem to be just the opposite of those which usually hold for seeds. In the first place we must assume that we have had a plant growing within or near tide limits and supplying food for mammals or birds, distributed over the adjacent islands. It is true that these seeds are now very hard and exceedingly bitter, but these qualities may have developed along with the others for which we are to account. Indeed, they have been asking favors of neither fowl nor beast but pleading in their own way to be simply let alone. From any particular crop of seeds those most conspicuous would be carried away first, and if any remained they would probably be those, which from their external characters, most resembled the pebbles about them. It would be these from which would be produced the new plants as the parents died out, or from which, when floated to adjacent shores, new colonies would be founded. It is believed, eminent authority to the contrary, that these would have a *tendency* to produce seeds somewhat similar. Very many of the conspicuous variety would continue to appear through a long series of generations, but it would be these always which would be first to be gathered and carried away. This selection continued through an indefinite time, combined with the tendency to transmit the parental characters to the offspring, would bring about the described results. In general, those seeds which fail to secure distribution are smothered out by the parent plant or by the favored one which gets the start of its fellows. Individual characters are soon obliterated through cross-fertilization. In the case of these beans, however, the waves and currents step in and quietly bear them to other shores where large numbers, which have been subjected to this selecting process, may have an opportunity for simultaneous growth and development. In the case of the Philippines there may thus take place with relative rapidity what might otherwise be impossible on a continuous stretch of coast alone. Somewhere upon the islands, either

upon the coast or inland, we should expect to find one or more related species, bearing conspicuous, softer and more palatable seeds (as in the case of the so-called "Florida bean"), the ancestors of which had been carried from the beach when the process of selection in the two directions began.—W. H. SHERZER, *State Normal School, Ypsilanti, Mich.*

Lichens, the only "thallophytes."—It is with great pleasure that I go through the new text-books of botany; their wealth of material and new views of classification are of extreme interest. The large amount of space devoted to cryptogams, more especially to the lower cryptogams, is in great contrast to the limited space accorded them in earlier works. The general method, too, is quite different; there is everywhere a severe strain after the homologies, while the analogies and affinities of the old botanists are scarcely considered.

We are furnished with new terms in vast profusion, contributing greatly to conciseness of thought and facility of expression. It would seem superfluous to ask for anything more in this respect; nevertheless it seems to me it would conduce greatly to ease and brevity of reference and description, to have a technical term for the vegetative system, and another for the reproductive system of plants in general. It is true that *vegetation* and *fructification* are made use of, but they are not technical terms, because they are employed with other meanings.

Fitting terms are used in some of the classes of plants. The vegetative and reproductive systems of a fungus are clearly and broadly indicated by *mycelium* and *sporophore*, those of a myxomycete by *plasmodium* and *sporangium*, of a lichen by *thallus* and *apothecium*. But in descriptive works upon the algæ, there is great confusion and uncertainty in the terms; we find cell, thread, filament, frond, stem, etc., in common use for the vegetative system and a greater multitude of terms for the reproductive system. These are all well enough in their special applications, but there is need of a pair of contrasting terms for each separate function in general. Wallroth, who was much given to invention of terms, employed the term *physeuma* to cover "frons, filum, caulis, folium" of Agardh.

This leads me to speak of the term *thallus*. The usage of the writers of the text-books and that of the writers of systematic works do not coincide. None of the latter speak of the *thallus* of a fungus; they say *mycelium*, or sometimes they revert to the component *hyphæ*. Even in certain cases where its use might be suggested, as in *Solenia anomala* Pers., we find the tubules "sitting on a *mycelium*," or in "*Peziza fusca* Pers., where the ascomata rest on a "*subiculum*." I have

not observed the *thallus* of the Myxomycetes to be written even in the text-books.

The use of the term *thallus* is now practically confined to the Lichens and more especially to the thin flat expansions, either foliaceous or crustaceous of the vegetative system. Its use in this same sense is transferred to certain plants not only among the Algæ but also in the Hepaticæ. Here, however, the better term would be *thallode*. Hence, so far as the usage of systematic works is concerned, the denomination Thallophyta of the text-books applies only to the lichens.

Finally, it is with some amazement that I view the new systems of classification in the most recent text-books. In the lower cryptogams there is an evident recoil to the Algæ and the Fungi, if not of Linnaeus, of Agardh and Fries. This is a return to a consideration of the vegetative system of these plants instead of the reproductive. On this account it would seem necessarily to involve the setting apart again of the lichens, whose vegetative system is now known to be unique among plants. Up to date, then, the gain in general classification has been only to segregate the Myxomycetes as an independent class. But in the development of the subordinate members of the scheme, the progress has been wonderful, though it is not yet by any means complete.—A. P. MORGAN, *Preston, O.*

Bibliography of American Botany.—The author catalogue on cards issued under the direction of the Bibliography Committee has completed its second year and is steadily growing. The first and smallest issue numbered seventeen cards; the largest (Nov. 1895) numbered 89 cards. The average monthly issue for 1894 was 49 cards, for 1895, 63 cards. The total issue for 1894 and 1895 is 1,343 cards.

In response to various requests an edition by subjects is in preparation, but as yet no fully satisfactory subject-classification has been found. Botanists would confer a great favor, and advance the work, by sending the committee any suggestions to this end, and particularly by stating what subjects and what phases of botanical science they would like to have the catalogues show, each for his special purpose. The committee is working in the interests of American botanists and wish to adapt the work to their needs. Address the Secretary of the Committee on Bibliography, 1286 Massachusetts Ave., Cambridge, Mass.

CURRENT LITERATURE.

Plant anatomy.

Most teachers of botany have felt the need of a brief and comprehensive account of the tissues of plants. Such a book—"a brief outline of the elementary principles of anatomy"—it has been the aim of of Dr. Emily L. Gregory of Barnard College to prepare.[1] The book is of very convenient size and appeals to one on this ground as probably just what he is in need of. A glance at the table of contents strengthens the favorable impression. The subject is logically and comprehensively mapped out. It is divided into two parts, the anatomy of the cell and anatomy of tissues, the latter including not only tissues and systems but also an outline of the anatomy of the vegetative body of the thallophytes and "cormophytes." When the body of the book is reached, the favorable impression is somewhat modified. Amid much that is good, well-put, and correct, there is much that is crude, incorrect, or out of date.

The explanation of the molecular structure of "organic substance" —by which we suppose organized bodies are meant—is defective, but the first striking weakness is encountered in the discussion of the cell nucleus. Here, in the absence of any recognition of the nucleus as determining the cell and therefore the ascription of a plurality of nuclei to one cell, in the statement that "the chemical nature of the nucleus is the same as that of the cytoplasm," in the incompleteness of the account of mitosis, and in the absence of any reference whatever to the centrospheres, we see indications that these parts of the lectures were prepared some time ago and have not been brought up to date.

It is in this section too that we meet again that unseemly phrase, which grates so often upon the teacher's ear from the mouths of students, "some scientists claim!" With variations, "it is also claimed," "it is claimed by some authorities," "it is believed by most authorities," etc., this crude expression recurs again and again, until we are forced to believe that the author had relinquished all hope that her book would be considered "an authority."

Other points also need to be revised in the light of more recent knowledge, such as the structure and chemistry of the starch grain, the function of leucoplasts, the epidermal system, the sieve tissue, and the types of stem structure.

[1] Gregory, Emily L.—Elements of plant anatomy. 8vo. pp. viii+148. figs. 64. Boston: Ginn & Co. 1895.

Of some statements we can find no explanation except that the author has mistaken the facts, but we cannot undertake to give illustrations of these. There is certainly confusion regarding the secondary bast fibers, that is those produced by the secondary meristem of the bundle, and the similar tissues arising from the pericycle. We cannot understand in what sense "tracheids are to the ducts what the accompanying [i. e., companion] cells are to the sieve-tubes of the phloem, namely assisting cells." If mono- and dicotyledonous types of stem structure are distinguished, is it not a serious objection to such a distinction to have to say regarding monocotyledons which undergo secondary thickening that "the stems which do admit of such increase may be considered as having changed from the mono- to the dicotyledonous type?" And this is unintelligible: "In general it [the cambium ring] may be said to be formed either by the intercalation of new bundles, or by the formation of interfascicular cambium." Is this "what is commonly called bark, namely all that portion of the stem outside the inner periderm?"

So we turn from the book with regret, wishing it were better, and hoping that by a careful revision Dr. Gregory will be able to furnish us a much needed text-book. It ought to be suggested to the publishers, also, that they seek to emulate the delicacy and softness of the illustrations in Strasburger's works, and avoid the coarse harsh style in which they have produced these.

Botany for pharmacists.

The book before us[1] is really a double one whose back title, side title, title pages and sub-titles are rather puzzling. The confusion, doubtless due to an inexperienced publisher, resolves itself thus: Drs. Rusby and Jeliffe have written for a pharmaceutical journal a series of articles, which are reprinted apparently from the original setting (as the pages are double columned), treating of the anatomy of plants from the point of view of the pharmacist. Dr. Rusby writes of gross structure and Dr. Jeliffe of histology.

Dr. Rusby, after a good introduction of five pages, devotes nearly two-thirds of his 100 pages to the flower, fruit, and seed, leaving only thirty-five for the other plant parts. The greater part of this section is a running glossary with only a cursory account of the morphology and physiology of the organs. In the "anthology" a confusing at-

[1] Essentials of vegetable pharmacognosy; a treatise on structural botany designed especially for pharmaceutical and medical students, pharmacists and physicians. Part I, The gross structure of plants, by Henry H. Rusby. Part II. The minute structure of plants by Smith Ely Jeliffe. 8vo. pp. vi + 150. figs. 560. New York: D. O. Haynes & Co. 1895.

tempt is made to present the modern view of the pollen-grains and ovules, as these sentences will show:

"These correspond, though of the other sex, to the macrospores which we have found the pistillate flowers to produce, and they are called microspores, in flowering plants called pollen-grains."

"If as in the alder, pistillate flowers and staminate flowers, or, otherwise stated, spores of both sexes, are produced by the same plant, it is monœcious.

The following account of the morphology of the anther, as well as the succeeding quotation regarding the pollen-grain, seem to indicate that the author has scarcely understood the homologies involved.

"Its origin from the leaf assumes the curving forward and inward of the margins of the blade to become attached to the face of the midrib, producing two thecæ, and the production of a secondary or "false" partition separating each theca longitudinally into two locelli."

"The pollen-grain consists of a highly hygroscopic mass of tissue, partly vital and partly nutritive."

The excellent illustrations, new, accurate, and clear, deserve high praise. Had they been numbered in type and an explanation or at least the names of each been given, it would have been a decided improvement.

Dr. Jeliffe's "outline of practical plant anatomy," as one title page calls it, is a greatly condensed account of the tissues, classified essentially as by Tschirch in his *Angewandte Pflanzenanatomie*, and illustrated by many cuts from that work. It is difficult to see how one who can write thus about the cell wall and the vacuoles can be fitted to prepare even an outline of plant histology:

"The lining membrane is called the cell wall. It is not always present, as in many one-celled plants, as yeast, nor is to be found in the youngest growing parts of the plant, as in the apices of stems and roots, nor in the immature pollen-grains."

"After the cells commence to grow portions of the cytoplasm are consumed in the building up of the plant, and small vacuoles appear in it."

"Vacuoles and other spaces left by the retreating protoplasm."

And this difficulty is increased when we find him defining "respiratory tissues" as "those which enable the plant to take in food from the atmosphere in the form of carbon dioxide and to give off oxygen and watery vapor."

While the authors' work is faulty in many particulars it is not easy to find any in which the publisher's is what it ought to be, if we except paper. The clumsy binding, the old brevier type in double columns loaded with capitals, the cuts numbered in two series while the pages are numbered consecutively, and the want of an index conspire to repel further acquaintance.

North American Cactaceæ.

Our North American species of *Cactaceæ* are now brought together[1] as a result of the studies of Dr. John M. Coulter.

The first part (no. 2, published in June, 1894) contained the genus *Cactus* (Mamillaria) and its small outliers, *Anhalonium* and *Lophophora;* the second part (no. 7, published in April, 1896) completes the work by presenting *Echinocactus*, *Cereus*, and *Opuntia.* The revision is called "preliminary" because confused and inadequate material, a badly tangled synonymy, and paucity of types could result in nothing else. It is also preliminary in the sense that it professes to do little more than to bring together the widely scattered material, sift it so far as possible, and thus lay the foundation for more elaborate study. It is probable that no group among the higher plants presents greater difficulties in the way of classification, both on account of the meager and fragmentary material, and also on account of the almost entirely unknown possibilities of variation. Having been very largely cultivated in Europe as well as America many modified forms have been produced, many garden species and varieties have been described, and these have vastly complicated the work of revision. It is certain that very many forms described, both in the revision before us and elsewhere, will be found undeserving of specific and varietal rank, but this can be discovered with certainty only by long continued and patient scientific cultivation. In few families are there such poorly defined generic lines, even our well-known North American genera exhibiting most puzzling intergrading forms. It may be safely said that in Cactaceæ there are few good species, as that term goes, and no genera. The monographer had a rare opportunity in his access to Dr. Engelmann's types and notes, many of the latter being first published in the present revision. If the North American species north of the Mexican boundary were the only ones concerned, some reasonable degree of certainty might be reached, but the well-nigh unknown cactus-flora of Mexico constitutes a necessary and unexplored background. Taking up the three genera of the *Contribution* just issued, we find *Echinocactus* containing fifty-two species and varieties, thirty-six of which are found within the United States; *Cereus* eighty-two species and varieties, of which twenty-nine are north of the Mexican boundary; and *Opuntia* 101 species and varieties, seventy-nine of which are found within our borders. It should be said, however, that this well represents only the forms found within the United States, as only such Mexican forms are included as could be examined. Numerous

[1] Contributions from the U. S. National Herbarium **3**: 91–132, 355–462.

new species indicated in Dr. Engelmann's manuscript notes and of the monographer are described, more by way of recording forms than with any expectation that they will stand the test of future investigation. Artificial keys supplement the presentation of each genus which will serve a useful purpose in recognizing material which is generally incomplete. It is hoped that this bringing together of our material in convenient shape will provoke investigation, especially since competent observers are multiplying in the cactus regions; and that the next revision will show large progress in our knowledge of this extremely interesting and perplexing group.

The bacteria.

In Engler & Prantl's *Die natürlichen Pflanzenfamilien*, the Schizomycetes or bacteria are united with the Schizophyceæ or fission-algæ into the Schizophyta. The first class has recently been issued as Lieferung 129, and is from the pen of Prof. W. Migula, the well-known bacteriologist.

The difficulties to be surmounted in a systematic treatment of the bacteria are well recognized. Their simplicity of structure and variability of function together with imperfect descriptions, the majority of which have been recorded by non-botanical bacteriologists and the almost interminably confused synonymy make an exhaustive treatment of this group practically impossible from a taxonomic standpoint.

Numerous systems of classification have been proposed from time to time, but many of these have been tentative, being based on convenience more than on natural affinities. Some have been constructed purely from the morphological standpoint, while others have assigned to functional characters a value equal to that of form.

Migula has prefaced his system with an exceedingly well written and concise account of the morphology and physiology of the bacteria. Reference is also made to geographical distribution, the relationship of the bacteria to closely allied groups, and some very pertinent observations on the subject of bacterial nomenclature. He deprecates the introduction of generic terms that are based on some biological property such as *Halibacterium* Fischer, *Photobacterium* Beyerinck, *Nitrosomonas* and *Nitromonas* of Winogradsky, inasmuch as these groups are well defined morphologically and can be satisfactorily arranged under the usual laws that govern systematic classification.

He further objects to the attempt to translate into Latin the species diagnosis and use it for a species name, as it is not only unwieldy in practice but is opposed to the present accepted taxonomic principles. For instance, *Bacillus fluorescens liquefaciens minutissimus* Unna and

similar titles are at variance with the accepted principles of the binomial nomenclature.

Migula's classification is based primarily on morphological and developmental differentiation, and in the selection of these characters he uses those that are the most permanent, subordinating the more transient, such as the presence and distribution of cilia, to lesser divisions.

The following synopsis gives the salient features of his system:

I. Cells when isolated spherical, not elongating before cell division. Cell division in 1, 2 or 3 planes. . . . . 1. *Coccaceæ.*

II. Cells cylindrical (short or long) dividing in only one plane, and elongating before division.

a. Cells straight, rod-like, devoid of sheath, immotile or motile by means of cilia, ... 2. *Bacteriaceæ.*

b. Cells curved, without sheath, ... 3. *Spirillaceæ.*

c. Cells surrounded with a sheath, . . . 4. *Chlamydobacteriaceæ.*

d. Cells without sheath, united into filaments, motile by undulating membranes, ... 5. *Beggiatoaceæ.*

The division of genera in the different families is likewise accomplished by the use of morphological characters such as the presence or absence of locomotor organs, protoplasmic inclusions like sulfur grains and, in the more specialized groups, the arrangement of cell filaments. Biological characters such pathogenicity, chromogenesis and zymogenesis are only used to differentiate related groups in various genera.

No attempt is made to classify all of the species already recorded, but a brief description is appended of a few representative forms under each group. The system will doubtless be regarded as the most successful attempt that has yet been made to outline the classification of this group on morphological lines.

It certainly represents an advance over any of its predecessors, and is superior to the contemporaneous systems that have been suggested within the last few years. The prestige of the publication of which it forms a part will doubtless strengthen its authority and lead to its adoption by botanical bacteriologists.—H. L. Russell.

Minor Notices.

The authors have recently issued decades XVII and XVIII of "*Hepaticæ Americanæ*, prepared by L. M. Underwood and O. F. Cook." It has been three years since the last decades were issued, and we are pleased to find that there has been no abatement of the original plan to issue exsiccatæ of all the North American species. There are nine

contributors, beside the authors, to the present score of numbers: C. V. Piper, D. H. Campbell, F. C. Straub, M. A. Howe, A. W. Evans, E. L. Rand, W. C. Werner, J. Macoun and A. B. Langlois. The species and place of collection are as follows: *Anthoceros laevis* L. and *A. Hallii* Aust. from Washington; *A. fusiformis* Aust., California; *A. Carolinianus* Michx., Florida; *Riccia nigrella* DC., California; *Aytonia erythrosperma* (Sull.) Underw., Washington; *Cyathophora quadrata* (Scop.) Trevis., New York; *Lepidozia sphagnicola* Evans, Connecticut; *Nardia Macounii* Underw. *n. sp.*, Washington; *Chiloscyphus polyanthos rivularis* Nees, California; *Plagiochila Virginica* Evans, District of Columbia; *Jungermania Novæ-Cæsareæ* Evans, New Jersey; *Cephalozia fluitans* (Nees) Spruce, Maine; *C. Turneri* (Hook.) Lindb., California; *Porella pinnata* L., Indiana; *Frullania Selwyniana* Pears., Ohio; *Lejeunea Macounii* Spruce, British Columbia; *L. serpyllifolia* (Dicks.) Lib., Florida; *Kantia Sprengelii* (Mart.), Louisiana; and *Blepharostoma nematodes* (Aust.), Florida.

OPEN LETTERS.

"Nature of the binary name," again.

Professor Greene does me an unmerited honor in discussing so fully my humble suggestion respecting the nature of the binary name. I asked if the name of a plant is one word or two. Professor Greene's reply is most ingenious and one which, I must admit, had never occurred to me. His chief reply is in the form of a suppositious case. He supposes that I could lecture for an hour or more on Carex, and mention any number of species, and yet not even once use the word Carex; therefore, the specific name is, in that case, *the name* of the plant. Very well; I might so lecture (to empty seats, of course); but my hearer (if, perchance, I should have one) would know that the word *Carex* is understood in every case. The group and the name of that group would be constantly in his mind. But if one were lecturing upon distribution of plants, morphology, or a dozen other botanical subjects, he would be obliged to use the generic name whenever he used a specific name, and both words—the combination—would appeal to every hearer as *the name.* It is a mere incident, it seems to me, whether the generic name is expressed or understood: in either case, both words are assumed as coordinate parts of the conception of a plant name.

I am sorry to be so obtuse and insistent. But I hope that Professor Greene will kindly help me still further out of my difficulty. The question which was propounded seems to me to be central to the whole nomenclatorial controversy. It seemed so five years ago, when I first ventured the proposition; but the fact that no one took up the issue seemed to show that my trouble was simply a personal perplexity and devoid of merit in itself.—L. H. BAILEY, *Cornell University, Ithaca, N. Y.*

NOTES AND NEWS.

DR. C. A. J. A. OUDEMANS has resigned the professorship of botany in the University of Amsterdam, on account of his advanced age.

THE *Icones Plantarum* is hereafter to be edited by the Director of Kew Gardens, a duty performed since 1891 by Professor Daniel Oliver.

DR. J. MUELLER, Director of the Botanic Garden and Curator of the Delessert Herbarium at Geneva, died January 28th in his 68th year.

MR. L. S. CHENEY, instructor in botany in the University of Wisconsin, has been promoted to be assistant professor of botany in the college of pharmacy.

THERE WERE more than 1,400,000 visitors at the Kew Gardens during 1895. The month of largest attendance was June, with nearly 300,000, and the smallest February, with little over 12,000.

THE NEW Mexican *Lippia iodantha* Rob. & Greenm. is figured in *Garden and Forest* for March 11th, with a brief informal description in "Notes of Mexican Travel" by C. G. Pringle.

A POPULAR ARTICLE on ferns by Willard N. Clute, profusely illustrated, and unusually well written, appears in the *Commercial Travelers' Home Magazine* for March (**6**: 271–278.)

PROF. D. T. MACDOUGAL, of the University of Minnesota, expects to spend the summer in Tübingen, in the laboratory of Prof. Vöchting, where he may be addressed during June, July and August.

E. KNOBLAUCH (*Ber. Deutsch. Bot. Gesell.* **13**: 289) announces the discovery of heterostylous flowers in several genera of *Gentianaceæ* notably *Hockinia*. This dimorphism is plainly correlated with the visits of insects.

ANOTHER PARASITE producing scab on potato tuber has been found in Hungary by K. Schilberscky (Ber. d. d. bot. Ges. **14**: 36–37). It belongs to the Chytridineæ, and is named by the discoverer, Chrysophlyctis endobiotica.

INTERESTING ACCOUNTS of the difficulties and pleasures met with in searching for the rare fern, *Schizæa pusilla*, are given in the April number of the *Linnæan Fern Bulletin*, by Mrs. Elizabeth G. Britton and Mr. C. F. Saunders.

DR. RODNEY H. TRUE has been promoted from instructor to assistant professor of pharmacognosy in the University of Wisconsin. Dr. True's thorough training in botany will enable him to give his students a genuine scientific background for their practical work.

MR. O. F. COOK, who made his third trip to Africa last October, is expected to land in New York about the middle of April. He spent less than three months in Liberia this trip, but reports a successful journey and large collections as usual. He returns via Hamburg and will spend some time in the Berlin museum before his return.

MESSRS. D. T. MacDougal of the University of Minnesota, Geo. J. Peirce of the State University of Indiana and R. A. Harper of Lake Forest University have recently been elected to membership in the Deutsche Botanische Gesellschaft.

WEED LEGISLATION in the United States has been summarized by L. H. Dewey in a very complete manner (Bull. U. S. Dept. Agric., Div. Bot., no. 17, 1896, pp. 60). The work must prove of much service to those who are interested in securing the assistance of the law in the fight against weeds.

THE RUSSIAN thistle is the subject of a bulletin by E. O. Wooton (N. M., no. 16). A general account is given. It was introduced into New Mexico in 1894 at Santa Fe. A revised edition of the circular on the Russian thistle by L. H. Dewey has been sent out by the U. S. Department of Agriculture.

THE ABRASION of tree trunks by snow and sleet driven by the wind was observed by Mr. P. M. Van Epps (*Science* **3**: 442) in a forest in New York. The bark was worn away on the westward side to the height of three or four feet above the surface of the snow, the freshly exposed surfaces giving a conspicuous dull yellow color.

AFTER A critical study of the ligule of Selaginella, Prof. H. Gibson, of University College, Liverpool, decides that the ligule is a specialized ramentum, and bases his conclusions on the very early development of the ligule in the history of the leaf, and the provision for a water supply for the ligule by the arrangement of the vascular bundle. (*Ann. Bot.* March.)—S. C. S.

IN COMMENTING upon Prof. Farlow's article in a recent number of this journal (**20**: 547) on the mimicry of parasitic fungi in insects, Dr. René Ferry (*Rev. Mycol.* **78**: 67) suggests that while insects which mimic healthy leaves receive protection from insect eating foes, those which mimic diseased leaves have an added protection from the incidental injury by leaf-eating enemies.

DR. CORRENS of Tübingen announces his discovery of irritability of tendrils to changes in temperature in the *Botanische Zeitung* for Jan. 16th. This fact, however, was discovered by Prof. D. T. Mac Dougal in the laboratory for plant physiology of Purdue University in November, 1892, and published in this journal (**18**: 125. 1893) together with some results on the chemical irritability of these organs—evidently unknown to Dr. Correns.

AMONG the new African plants discovered by Dr. A. Donaldson Smith are two new genera, *Donaldsonia* Baker, said to suggest technically Pittosporeæ, also showing affinity with Passifloreæ, but not assigned to any family by the author; and *Gillettia* Rendle, belonging to the Commelinaceæ. Both are described and illustrated in *Journ. Bot.* (Feb.). *Baseonema* Schlechter & Rendle is another new African genus, belonging to the Asclepiadaceæ, described and figured in *Journ. Bot.* (March).

SOME interesting records of experiments showing the action of acid potassic oxalate on Elodea and Oxalis, with regard to its effect on the changing of starch to sugar, are given in the March number of the *Annals of Botany*. It is found that a lack of calcium as a counteractant, allows the acid potassic oxalate to prevent the change of starch to sugar, and thus to deprive the plant of all the carbon present in a starch-condition, although the conduction of the other carbohydrates is not interfered with.—S. C. S.

IN AN ILLUSTRATED article in the *Tokyo Bot. Magazine* (**10**: 16–20) Prof. Y. Takahashi shows the identity of *Tilletia oryzæ* Pat. with *Ustilago virens* Cke, a fungus that has recently been demonstrated by Brefeld[1] to be one of the *fungi imperfecti*, and not one of the Ustilagineæ. A new species of Tilletia, *T. horrida*, is described, so far the only genuine Ustilaginea found on Oryza sativa. It is notable for the very long acute spines of the epispore.

BOWER continues his "Studies in the morphology of spore-producing members,"[1] taking up Ophioglossaceæ. His object is "the following out of the probable methods of progression in the evolution of the more complex from the simpler types." The four methods given are septation, branching, reversion of vegetative parts to sporogenous condition, and eruption of appendicular organs from a previously smooth surface. The sporangiophores of Helminthostachys are cited as an example of the last.—S. C. S.

DR. J. E. HUMPHREY, of Johns Hopkins University, gives in the *Annals of Botany* for March, the results of a careful study of all available material on the seed development of the Scitamineæ. He finds "in the characteristic formation of the micropylar collar, in the persistence of the micropylar epidermis over the apex of the embryo-sac, in the very common development of a micropylar aril and in the direct development of the embryo, the features of the seed which are to be regarded as most characteristic of the Scitamineæ;" the genus *Canna* departs sufficiently from these characters to be made the type genus of a distinct family.—S. C. S.

THE *Proc. Philad. Acad.*, 1895, Part III, contains the following material of botanical interest: about 100 new species of fungi, including a new genus (*Stilbomyces*), by Ellis and Everhart; a series of corrections of Mr. W. E. Meehan's determination of his Greenland collection, by Theo. Holm; a second instalment of Professor E. L. Greene's "Eclogæ Botanicæ," in which he describes numerous new western plants and revises the genus *Tropidocarpum;* notes on the study of cross-fertilization of flowers by insects, by Ida A. Keller, which is simply a résumé of the subject, and in which we would suggest the substitution of "pollination" for "fertilization."

PROFESSOR STRASBURGER, in his *résumé* of recent work in vegetable cytology, discusses the behavior and function of the nucleolus during karyokinesis, and confirms the statements of other observers as to its

[1] Unters. a. d. Gesammtgeb. d. Myk. Heft. XII, 1895.
[1] Proc. Roy. Soc. 59: —.

frequent fragmentation and partial distribution in the cytoplasm at that period. He suggests that it provides the material for the construction of the achromatic spindle. This body he considers to consist of two parts, a central strand of unbroken fibers, which stretch from pole to pole, and along which the chromosomes slide, and an outer group of fibers, which end at the equator on the chromosomes themselves. These latter fibers are effective in conveying the daughter-chromosomes to their respectives poles.—*Jour. Roy. Micr. Soc.* (Feb.).

Mr. George Massee, in *Kew Bulletin* (Jan.) describes and figures *Rosellinia radiciperda*, a new and very destructive root-fungus of New Zealand. It seems to be almost omnivorous in its ravages, attacking all common orchard trees, cabbages, potatoes, etc. It is most plentiful "on the skirts of the primeval forests and on fern lands adjoining where no cultivation has ever been resorted to. Whole crops of potatoes are destroyed on such lands, and on dry lands where native tree stumps remain it is very prevalent." It seems that fungus pests are far more dreaded in New Zealand than any ravages by insects. The new fungus resembles *Dematophora necatrix*, the form producing the root-disease well-known as "pourridié" in central and western Europe.

Mr. Walter Deane has in preparation a flora of the extensive system of metropolitan parks in Boston and vicinity. It will make a volume of about 150 pages, of which more than half are already printed (Apr. 15). This system of parks, created by the Massachusetts legislature and under the control of a special commission, is the most extensive of any in the world. The Arnold Arboretum is included in the system. Several millions have already been expended in improving them, and the work, though only well begun, is being prosecuted with vigor. It is well to have an available flora of these districtss, and Mr. Deane's thorough acquaintance with the seed plants of the region fits him well for the task.

Mr. D. T. MacDougal has been studying the root-tubers of *Isopyrum biternatum* from a physiological standpoint, his results being published as a reprint (March 31) in the advance of the *Minn. Bot. Studies*. He finds that the tubers are formed by an excessive development of the pericycle; that the feeble mechanical elements in elongated tubers are compensated for by the habit of penetrating a loose substratum; that the product of photosyntax is probably cane-sugar, which finally accumulates in the tubers in the same form; that the tendency to form "red starch" is characteristic; that the tendency to form tubers is firmly fixed, resisting even in an apparently starving condition in water cultu es; and that the sap of the external tissues contains a bitter substance, which may serve as protection against animals and fungi.

Two recent contributions from Professor R. A. Harper in *Ber. d. deut. bot. Gesell.* present some of the results of his studies among the Ascomycetes. One contribution records observations on the development of the perithecium in *Sphærotheca Castagnei*, in which the author has succeeded in following the whole process of sex-reproduction, a result which goes far towards settling this disputed question

among Ascomycetes. Branches develop from neighboring filaments, one of which produces an oogonium, the other an antheridium. The latter becomes curved and closely applied to the former; the walls at the point of contact are absorbed; and the two gametes fuse. The subsequent part played by the basal cell of the oogonium in the construction of the perithecium, and the development of the asci and their spores, are fully described. The other paper is a contribution to nuclear division and spore-formation in as ascus, *Peziza Stevensoniana* and *Ascobolus furfuraceus* having been used.

AT THE meeting of the Academy of Science of St. Louis, on March 16th, Dr. Wm. Trelease presented some of the results of a recent study of the poplars of North America, made by him for the Systematic Botany of North America, and exhibited specimens of the several species and recognized varieties. Specimens were also exhibited of an apparently undescribed poplar from the mountains of northern Mexico, which he proposed to characterize shortly, and, for comparison, specimens of the two other species of poplar known to occur in Mexico, and of the European allies of the supposed new species, were laid before the Academy. The paper was discussed by Drs. Green, Glatfelter, and Kinner, Mr. Winslow, and Professor Kinealy.

The Academy, in cooperation with the joint committee of the scientific societies of Washington, adopted resolutions favoring the appointment of a permanent chief for the scientific work of the United States Department of Agriculture.

S. NAWASCHIN is rapidly adding to the list of chalazogamic forms. In *Bot. Centralbl.* (63: 353) he gives an account of the discovery of chalazogamy in *Juglans regia*, which shows several peculiar features. The single ovule completely fills the ovary cavity, there being also a wing-like outgrowth on each side of the placenta. The pollen-tube does not even enter the stylar canal or any cavity whatsoever, but advances in intercellular fashion down the style and ovary wall until the placental outgrowths are reached, through which an intercellular passage is effected to the chalaza, through the nucellus, and so to the embryo-sac. The pollen-tube is said to branch freely, so that the tissue of the nucellus seems veined by tubes surrounding the embryo-sac on all sides. The author detected the male pronuclei within the embryo-sac, which he describes as wandering through the protoplasm of the embryo-sac until they meet and coalesce with one of the several free nuclei which function as oospheres but have not been differentiated into an "egg-apparatus."

THE FOLLOWING experiment station bulletins, recently published, pertain to vegetable pathology: Spraying experiments in 1895, by H. Garman (Ky., no. 59) gave favorable results with Bordeaux mixture on apples, and negative results with iron sulphate; Spraying orchards and vineyards, by J. C. Whitten (Mo., no. 31) reports favorable results with Bordeaux mixture; Experiments in the treatment of peach rot and of apple scab, by F. D. Chester (Del., no. 29) reports favorable results with several copper compounds; The smut of oats and its prevention, by Aug. D. Selby (Ohio, no. 64) gives a good general account of the disease, and favorable results with use of hot water and potassium sul-

phite; Treatment of some fungous diseases, by L. M. Underwood and F. S. Earle (Ala., no. 69) gives a general account of the most prominent plant diseases, and their treatment; Bacteriosis of carnations, by J. C. Arthur (Ind., no. 59) reports the results of an extended study of the disease, with methods of treatment; Field experiments with potatoes, by B. D. Halsted (N. J., no. 112) reports favorable treatment of potato scab and sweet potato rot with lime, sulphur, corrosive sublimate and sulphate of copper; Diseases of the potato, by E. G. Lodeman (Cornell, no. 113) treats of early and late blight, scab, and beetles. There are evidences of hasty preparation in this bulletin, and some errors of statement have crept in, for instance, the description of oospores in Phytophthora infestans, although no such structures have yet been discovered.

Faxon del.

DAVENPORT on FILICES MEXICANÆ.